DICTIONARY

OF

THE ECONOMIC PRODUCTS OF INDIA.

BY

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(ASSISTED BY NUMEROUS CONTRIBUTORS.)

IN SIX VOLUMES.

VOLUME V.,

Linum to Oyster.

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OIL. Chemical Composition.

reaction conducted according to Poutet's directions yielded a solid firm yellowish product after eighteen hours, the temperature in the laboratory varying between 89° and 93° F. Exposed in a thin layer on a glass plate to a temperature of 100°C. for some days the oil did not dry or become tacky. The oil was easily soluble in ether, chloroform, carbon bisulphide, benzole, &c. Absolute alcohol, agitated with it was coloured greenish; on separating the alcohol, and evaporating off the spirit, an extract was obtained which consisted of oil, from which a small residue, whitish in colour, separated on standing. The alcoholic extract was very bitter, and possessed in a marked degree the peculiar odour of the oil The whitish residue deposited from the oil separated by alcohol, and examined microscopically, did not appear crystalline. Margosa oil after repeated agitation with alcohol was found to have lost its bitterness and almost wholly its alliaceous odour.

"A known weight of the oil was saponified with alcoholic potash, the alcohol completely evaporated off, and the soap dissolved in water. On agitating the aqueous solution of the soap with ether, 1·60 per cent. of ether extract was obtained of an orange-yellow colour and bitter. This extract, treated with 60 per cent. alcohol, left a small amount of white residue, which had the character of a wax. The aqueous solution of the soap, after separation of the ether, was heated for some time to remove dissolved ether, the solution was then mixed with dilute sulphuric acid in excess, and the insoluble separated from the soluble fat acids in the manner recommended by Allen. The soluble fatty acids amounted to 3·519 per cent., the insoluble to 89·128 per cent. The volatile acids consisted of butyric and a trace of valeric acid. During the distillation to separate the fluid from the volatile fatty acids, a small amount of a snow—white fatty acid passed over; this acid had a melting point of 43·6° C., which corresponds with the fusing point of lauric acid. A weighed portion of the insoluble fatty acids, from which the lauric acid had not been separated, was dissolved in alcohol, and titrated with normal standard soda, using phenolphthalein as an indicator, ·288 gram of the acids required 1 c.c. of caustic soda for neutralization. No attempt at separating the fixed fatty acids was made; they probably consisted of a mixture of stearic and oleic acids, with a small amount of lauric acid.

"Examined by Reichert's distillation process, 2·5 grams of the oil gave a distillate which after separation of the lauric acid, which had distilled minder, required 4·6 c.c. of decinormal soda for neutralization, phenolphthalein being used as an indicator.

"The saponification equivalent of the oil was determined by Koettstorfer's method, and was equal to 284, the percentage of caustic potash required to saponify the oil being 10·72.

"A preliminary examination of the oil having indicated the presence of sulphur, a quantitative estimation of the amount present was made and found equal to ·427 per cent The oil after repeated agitation with alcohol was found to contain only ·109 per cent. of sulphur.

"The extract obtained by agitating the oil with absolute alcohol has already been referred to; it was examined in the following manner:—The oily extract was treated with 60 per cent spirit, allowed to stand, and the clear yellow alcoholic solution decanted from the insoluble oil; the alcoholic solution thus obtained was evaporated to dryness, mixed with ammonia, and agitated with ether. The ether solution was marked *A*. The aqueous solution, after separation of the ether, was mixed with dilute hydrochloric acid, and again agitated with ether. The ether separated of a yellow colour, and below it some flocks of a dirty yellow hue, which refused to dissolve after prolonged agitation. The ether solution was marked *B*.

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LINUM, *Linn.; Gen. Pl., I., 242.*

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Linum mysorense, *Heyne; Fl. Br. Ind., I., 411;* LINEÆ. ☞ 380

Syn.—L. HUMILE, *Heyne.*

References.—*Atkinson, Him. Dist., 306; Dals. & Gibs., Bomb. Fl., 16; Gazetteers:—Mysore and Coorg, I., 56; Bombay (Kanara District), XV., 428.*

Habitat.—An annual herb with a corymbosely branched, slender, glabrous stem: found on the exposed hills of the Western Peninsula from the Konkan and the Deccan to the Nilghiri hills. Also on the Western Himálaya at Garhwál between 3,000 and 5,000 feet, distributed to Ceylon at altitudes of 4,000 to 5,000 feet.

L. strictum, *Linn.; Fl. Br. Ind., 411.* ☞ 381

Vern.—*Basant, bab-basant,* PB.

Habitat.—A small, herbaceous plant with yellow flowers, found on the Panjáb hills and in Tibet (at an altitude of 10,000 feet); cultivated in Afghánistán.

Oil.—Griffith says it is grown in Afghánistán on account of its oil-yielding SEED, not for flax. The oil very probably does not differ essentially from ordinary linseed oil. OIL. Seed. ☞ 382

L. perenne, *Linn.; Fl. Br. Ind., I., 411.* ☞ 383

Reference.—*Stewart, Pb. Pl., 20.*

Habitat.—A perennial herb, branching from the ground and growing to a height of from 1 to 3 feet; found in Western Tibet and Lahoul at altitudes of 9,000 to 13,000 feet.

Oil.—Stewart suggests that this may be the plant which afforded the wild linseed of Spiti which many years ago was sent to the Agri.-Horticultural Society of India. Aitchison, in his *Lahoul, its Flora and Vegetable Products*, mentions this plant, but states that the people are ignorant of its fibre, and, when speaking of oils, he says none are used, except the oil prepared from species of Impatiens, and that even that oil is only employed to polish drinking cups. No plants, Aitchison adds, are cultivated in Lahoul as sources of oil. Ghi, or clarified butter, is the only substance used for lighting purposes. Thus these wild hill people appear to be alike ignorant of the oil and fibre of their indigenous Linum. OIL. Seed. ☞ 384

L. trigynum, *Roxb.;* see Reinwardtia trigyna, *Planch.;* Vol. VI.

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Linum usitatissimum, *Linn.; Fl. Br. Ind., I., 410.*

LINUM, *Latin;* LIN, *Fr.;* LINO, *It. & Spanish;* LINHO, *Port.;* FLÜCHS, *Germ.;* VLAS, *Dutch.*

Syn.—L. TRINERVIUM, *Roth.*

Vern.—*Alsí, tísí,* HIND.; *Tisí, masiná* (=smooth), BENG.; *Tisi, chikna,* BEHAR; *Pesu,* URIYA; *Bijri* (Banda), N.-W. P.; *Tisí, alsi,* KUMAON; *Keun, alish,* KASHMIR; *Alish, tisi, alsi,* PB.; *Zighir,* KASHGHAR; *Alási, javasa, javas,* BOMB.; *Alshi,* GUZ.; *Alshi, javas,* DEC.; *Alshi-virai,* TAM.; *Atasi, ullá súlú, madan-ginjalu,* TEL.; *Alshi, alashi,* KAN; *Cheru-chána-vittinte-vilta,* MALAY.; *Atasi, auma, malika, san, masrind* or *masína, masúna* (*kskauma,* according to Mason's *Burma*), *uma* (according to Sir W. Jones, SANS.; *Ziggar,* TURKI; *Kattán* (or *basrut-kattán*), ARAB.; *Zaghú, zaghir, kutan* (or *tukhme-katán*), PERS.

NOTE.—It has been found impossible to separate the names given to the plant, the fibre, the seed, or the oil: they are, therefore, all included together in the above enumeration.

References.—*Roxb., Fl. Ind., Ed. C.B.C., 277; Dals. & Gibs., Bomb. Fl., Supp., 16; Stewart, Pb. Pl., 21; DC. Origin Cult. Pl., 119; Elliot, Flora Andhr., 17, 123; Mason, Burma and Its People, 517; Sir W. Jones, Treat. Pl. Ind., 107; Planchon, Hooker's Jour. of Botany, Vol. VII., 165, published 1848; Grierson, Peasant Life, 246; Carey, Asiatic Researches, X., 15; Pharm. Ind., 37; Dymock, Warden, & Hooper, Pharmacog. Ind., I., 239; Ainslie, Mat. Ind., I., 196, 612; O'Shaughnessy, Beng. Dispens., 213; U. C. Dutt, Mat. Med. Hind., 292; Dymock, Mat. Med. W. Ind., 2nd Ed., 116; Flück & Hanb. Pharm.; Fleming, Med. Pl. and Drugs, as in As. Res., Vol. XI., 170; Bent. & Trim., Med. Pl., 39; S. Arjun, Bomb. Drugs, 27; Murray, Pl. and Drugs, Sind, 93; Irvine, Mat. Med., Patna, 116; Butler, Med. Top. Oudh, 32; Rankine, Med. Top. of Sarem, 15; Year Book, Pharm., 1874, 268, 623; Moodeen Sheriff, Mat. Med. S. Ind. (proof seen by the writer), 69; Baden Powell, Pb. Pr., 420, 496-500; Atkinson, Him. Dist., 306, 740-771; Drury, U. Pl., 278; Duthie & Fuller, Field and Garden Crops, 40-42; Lisboa, U. Pl. Bomb., 215, 231; Birdwood, Bomb. Pr., 16, 280, 316; Royle, Ill. Him. Bot., 82; Christy. Com. Pl. and Drugs, VI., 10; Royle, Fib. Pl., 135 232; Liotard, Paper-making Mat., 15, 17, 24; Spons, Encyclop., 964-978, 1393-4, 2024; Balfour, Cyclop., I., 1127; II. 719; Smith, Dic., 178, 247; Ure, Dic, Indus., Arts, and Manu., II., 326, 375, also 876-879; Kew Off. Guide to the Mus. of Ec. Bot., 22; Simmonds, Trop. Agri., 399; Linschoten, Voyage to East Indies, I. 80; Gazetteers:—Mysore & Coorg, I., 58; Bombay, IV., 53; XII., 152; XVII., 270; C. P., 327; N.-W. P., I., 79; II., 159; III., 225; IV., lxix; Panjab, Hoshiarpur, 91; Gujrát, 78, 79; Gujranwalla, 53; Sialkot, 76; Hunter's Orissa. II., App., 15; Indian Forester, IX., 274; Settle. Repts.:—Chánda, 81, 96; Gugrat, vxxix.; Banda, 50; Azamgarh, 123; Bareilly, 82; Lahore, 9; Baitool, 77; Kángra, 24; Allahabad, 31; Hoshungabad, 276, 277, 288; Nagpur, 273; Nursingpore, 52; Nimár, 198; Kumaon, App., 34; Wardhá, 68; Madras, Man. of Admn., I., 288; Administration Repts.:—Bengal, 1882-83, 17; Quarterly Journals of Agriculture, V., 467; VI., 101, 449; X., 37; XI., 314.*

Habitat.—An annual herbaceous plant cultivated throughout the plains of India and up to altitudes of 6,000 feet above the sea.

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The history of both FLAX and LINSEED may be treated conjointly, since, to the India of the present day, linseed alone is of commercial importance. Flückiger & Hanbury give a brief but interesting sketch of this subject. "The history of flax, its textile fibre and seed," these authors write, "is intimately connected with that of human civilization. The whole process of converting the plant into fibre, fit for weaving into cloth, is frequently depicted on the wall paintings of the Egyptian tombs. The grave-clothes of the old Egyptians were made of flax, and the uses of the fibre in Egypt may be traced back, according to Unger, as far as the twenty-third

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century B.C. The old literature of the Hebrews and Greeks contains frequent reference to tissues of flax; and fabrics woven of flax have actually been discovered, together with fruits and seeds of the plant, in the remains of the ancient pile-dwellings bordering the lakes of Switzerland."

"The seed in ancient times played an important part in the alimentation of man. Among the Greeks, Alcman in the seventh century B.C., and the historian Thucydides, and among the Romans, Pliny, mention linseed as employed for human food. The roasted seed is still eaten by the Abyssinians." (Conf. with remarks below regarding its being eaten in India.)

"Theophrastus expressly alludes to the mucilaginous and oily properti es of the seed. Pliny and Dioscorides were acquainted with its medicinal application, both external and internal."

"The propagation of flax in Northern Europe as of so many other useful plants, was promoted by Charlemagne. It seems to have reached Sweden and Norway before the 12th century."

The above passages have been taken from the *Pharmacographia*, a learned work which appeared subsequent to DeCandolle's historic sketch of Linum (*Geogr. Bot. Rais., 833*). These two works have brought together, in fact, all that can be said regarding the history of flax and linseed. It may not, therefore, be out of place to give here some of DeCandolle's more recent observations (*Origin. Cult. Pl.*): "The first important work on this subject," he writes, "was by Planchon in 1848. That botanist clearly showed the difference between Linum usitatissimum, L. humile, and L. angustifolium, which were little known. Afterwards Heer, when making profound researches into ancient cultivation, went again into the characters indicated, and by adding the study of two intermediate forms, as well as the comparison of a great number of specimens, he arrived at the conclusion that there was a single species, composed of several slightly different forms" Commenting on Heer's definitions of these forms DeCandolle adds:—"It may be seen how easily one form passes into another. The quality of annual, biennial, or perennial, which Heer suspected to be uncertain, is vague, especially for angustifolium; Loret, who has observed the flax in the neighbourhood of Montpellier, says:—'In very hot countries it is nearly always an annual, and this is the case in Sicily according to Eussone; with us it is annual, biennial, or perennial according to the nature of the soil in which it grows; and this may be ascertained by observing it on the shore, notably at Maguelone. Then it may be seen that along the borders of trodden paths it lasts longer than on sand, where the sun soon dries up the roots, and the acidity of soil prevents the plant from enduring more than a year.'" It may, in fact, be accepted that Heer established L. usitatissimum as a cultivated race derived from L. angustifolium. The annual flax (L. usitatissimum) of which there are two special forms, *viz.*, α vulgare and β humile, has not been found, with absolute certainty, in a wild state. It is the cultivated form met with in the greater part of India, while variety β extends into Persia. Boissier mentions a specimen collected by Kotschy at "Shiraz in Persia, at the foot of the mountain called Sabst Buchom." "This is perhaps a spot," adds DeCandolle, "far removed from cultivation; but I cannot give satisfactory information on this head."

"Linum angustifolium, which hardly differs from the preceding, has a well-defined and rather large area. It grows wild, especially on hills throughout the region of which the Mediterranean forms the centre, that is, in the Canaries, and Madeira, in Morocco, Algeria, and as far as the Cyrenaic; from the south of Europe as far as England, the Alps, and the Balkan Mountains, and lastly, in Asia from the south of the Caucasus to Lebanon and Palestine. I do not find it in the Crimea, nor beyond the Caspian Sea."

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Having thus reviewed the botanic evidence DeCandolle turns to the philologic : "The widely different commercial names indicate likewise an ancient cultivation or long use in different countries. The Keltic name *lin*, and Greco-Latin *linon* or *linum*, have no analogy with the Hebrew *pischta* nor with the Sanskrit names *ooma*, *atasi*, *utasi*. The varying etymology of the names, the antiquity of cultivation in Egypt, in Europe, and in the north of India, the circumstance that in the latter country flax is cultivated for the yield of oil alone, lead me to believe that two or three species of different origin, confounded by most authors under the name of **Linum usitatissimum**, were formerly cultivated in different countries, without imitation or communication the one with the other. I am very doubtful whether the species cultivated by the ancient Egyptians was the species indigenous in Russia and in Siberia." These were DeCandolle's remarks in his earlier work, and they were abundantly confirmed by subsequent research, for, in his *Origin of Cultivated Plants*, he continues : "My conjectures were confirmed ten years later by a very curious discovery made by Oswald Heer." DeCandolle then goes on to describe Heer's discovery, which has already been indicated by the above remarks regarding the discovery of the fruits of **L. angustifolium** in the lake-dwellings of Eastern Switzerland, denoting an acquaintance with **Linum** at a time when stone implements were being used. **L. angustifolium** is wild south of the Alps. The interest in Heer's discovery was confirmed by his finding also the seeds of **Silene cretica**, a plant foreign to Switzerland but abundant in Italy in flax fields. Hence Heer concluded that the Swiss lake-dwellers imported the seeds of their flax from Italy. The same form of flax has also been recognised in the peat-mosses of Lagozza in Lombardy. The prehistoric people of that region were, like the Swiss, lake-dwellers ignorant of hemp, and used stone implements, but possessed the same cereals and ate like them the acorns of **Qurcus robur**, *var.* **sessiliflora**. There was thus, DeCandolle adds, a civilization on both sides of the Alps in which **L. angustifolium** was used—a civilization probably anterior to the Aryan advent in Europe. This idea is confirmed, DeCandolle thinks, by philological considerations. The word *lin*, *llin*, *linu*, *linon*, *linum*, *lein*, *lan*, exists in all the European languages of Aryan origin of the centre and south of Europe, but as it is not common to the Aryan languages of India, the cultivation of flax most probably took its origin with the Western Aryans, and before their arrival in Europe. "The name *flachs* or flax of the Teutonic languages comes from the old German *flahs*. There are also special names in the north-west of Europe—*pellawa*, *aiwina*, in Finnish ; *hor*, *härr*, *hor*, in Danish ; *hor* and *tone* in ancient Gothic. *Haar* exists in the German of Salzburg. This word may be in the ordinary sense of the German for thread or hair, as the name *li* may be connected with the same root as *ligare*, to bind, and as *hor*, in the plural *hörvar*, is connected by philologists with *harva*, the German root for *flachs* ; but it is, nevertheless, a fact that in Scandinavian countries and in Finland, terms have been used which differ from those employed throughout the south of Europe. This variety shows the antiquity of the cultivation, and agrees with the fact that the lake-dwellers of Switzerland and Italy cultivated a species of flax before the first invasion of the Aryans." "It is not known precisely at what epoch the cultivation of the annual flax in Italy took the place of that of the perennial, **Linum angustifolium**, but it must have been before the Christian era ; for Latin authors speak of a well-established cultivation, and Pliny says that the flax was sown in spring and rooted up in the summer." If it had been the perennial crop, the plant would have been cut so as to leave the roots in the ground. In a like manner the annual flax must have been grown in ancient Egypt, as it is at the present time since the old paintings shew it being uprooted. "Now it is

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known," continues DeCandolle, "that the Egyptians of the first dynasties before Cheops belonged to a proto-semitic race, which came into Egypt by the Isthmus of Suez. Flax has been found in a tomb of ancient Chaldea prior to the existence of Babylon, and its use in this region is lost in the most remote antiquity Thus the first Egyptians, of white race, may have imported the cultivation of flax, or their immediate successors may have received it from Asia before the epoch of the Phœnician colonies in Greece, and before direct communication was established between Greece and Egypt under the fourteenth dynasty.

"A very early introduction of the plant into Egypt from Asia does not prevent us from admitting that it was at different times taken from the east to the west at a later epoch than that of the first Egyptian dynasties. Thus the western Aryans and the Phœnicians may have introduced into Europe a flax more advantageous than **L. angustifolium**, during the period from 2,500 to 1,200 years before our era."

"The sum of the facts and probabilities," concludes DeCandolle, "appear to me to lead to the following statements which may be accepted until they are modified by further discoveries :—

"1. **Linum angustifolium**, usually perennial, rarely biennial or annual, which is found wild from the Canary Isles to Palestine and the Caucasus, was cutivated in Switzerland and the north of Italy by peoples more ancient than the conquerors of the Aryan race. Its cultivation was replaced by that of the annual flax.

"2. The annual flax (**L. usitatissimum**), cultivated for at least four thousand or five thousand years in Mesopotamia, Assyria, and Egypt, was, and still is, wild in the districts included between the Persian Gulf, the Caspian Sea, and the Black Sea.

"3. This annual flax appears to have been introduced into the north of Europe by the Finns (of Turanian race), afterwards into the rest of Europe by the western Aryans, and perhaps here and there by the Phœnicians; lastly into Hindustan by the eastern Aryans, after their separation from the European Aryans.

"4. These two principal forms or conditions of flax exist in cultivation, and have probably been wild in their modern areas for the last five thousand years at least. It is not possible to guess at their previous condition. Their transitions and varieties are so numerous that they may be considered as one species comprising two or three hereditary varieties, which are each again divided into subvarieties."

Very little information of a historical character can be given regarding flax in India. The subject has not been carefully gone into, but from what has been written it would appear that the Muhammadans have always given more attention to it than the Hindus. According to most writers certain Sanskrit names, which occur in some of the early works, are assigned to it. If, for example, the *Kshaumá* garments, alluded to in the Rámáyana and Mahábharata, be accepted, as having been made, as many writers maintain, of *Kshuma* or *Ksumá, i.e.*, linen—synonyms *Umá, Haimavati, Atasí* and *Marsina*—then the fibre must have been well known to the Sanskrit speaking people from very ancient times. But there is some doubt on this point. *Kshauma*, the name which of all others would carry the Asiatic knowledge in linen furthest back, is by some writers supposed to denote silk: indeed, its resemblance to *Chumá*, the Chinese for grass-cloth, has been even suggested as worthy of consideration. In the Institutes of Manu, mantles of woven *Kshumá* are those directed to be worn by theological students of the military class. Commenting on this subject Mr. Hem Chunder Kerr (*Cultivation of, and Trade in, Jute, p. 11*) says "So recently as 300 years ago Kavi Kankana, in the *Bengali Chandi*, de-

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scribed a female punished by being obliged to dress in *Kshauma* cloth and to tend goats." "In this instance," adds Mr. Kerr, "the cloth obviously was a coarse or sack cloth. In the Puránas references to the *Kshauma* cloth are frequent, but do not indicate its nature or character. In the *Ain-i-Akbarí* a linen cap is described as part of the dress of a Brahmachári (Vol. II., p. 483). Anyhow it is abundantly evident that, as in other parts of the world, so in India, the true flax was known and manufactured from very early times, but that within the last two hundred years it has entirely lost its ground; and in Bengal, in the present day, a man would be laughed at who would say to the cultivators that the stalks of their well-known *tisi* are rich in fibre, and could by proper management yield a valuable fibre." The writer has failed to find the passage, given above by Mr. Kerr, in Gladwin's or Blochmann's translations of the *Ain-i-Akbari*, nor has he come across, in that most valuable work, any other passage that alludes to flax or linen. Linseed is, however, mentioned in the *rabi* harvest crops of Agra, Allahabad, Oudh, Delhi, Lahore, Multan, and Malwa, so that one might be disposed to think the oil had been as well known in 1590 (date of the *Ain-i-Akbarí*) as at the present day. Linschoten, who visited India in the sixteenth century, mentions by name a fibre found in Ceylon which his translators have rendered flax, but he says nothing of flax or linseed in India. Tavernier is silent as to flax and linseed, though he describes the field-crops over a part of India that he certainly could not have crossed without noting the abundance of this crop, had it been as at the present day, of primary importance. Linschoten was one of the most remarkable travellers who ever visited India and the East. While speaking of China he says: "In China there is much Flax and Cotton, and so good and cheap that it is almost incredible." But may not the flax there mentioned have been China-grass, *chuma?* To the people of India edible oils only are of importance, and probably the non-edible ones were never more so than at present. Before the foreign demand, therefore, it seems highly probable that Linseed was of little or no value to them. Added to all this it is certainly significant that neither Rheede nor Rumphius describe any species of Linum as seen by them in India, and that even Burmann is silent on the subject, though his *Flora Indica* appeared so late as 1768.

The first detailed article, in fact, on the subject of flax which the writer has been able to consult, is that written by the late Revd. W. Carey, which appeared early in the present century. The correspondence of the Hon'ble the East India Company is of course dated a few years earlier, and Roxburgh wrote of it much about the same period as Carey. The flax or linseed plant, though very probably grown by the people of India long anterior to the date of Carey's paper, had apparently lost the importance once attached to it by the Muhammadan rulers. It would seem to owe its present value in Asiatic agriculture like tea, coffee, jute, wheat, cotton, &c., &c., to European influence and commerce. Ainslie in 1826 wrote of it: "There is a great deal of flax *now** cultivated in many parts of Upper India, and especially in Bengal, for making oil, and of *late years** it has also become an object in the lower provinces." Thus Ainslie viewed it as a modern agricultural crop. U. C. Dutt gives it its Sanskrit and Bengali names, but makes no mention of its properties having been known to the Sanskrit physicians. Even a stronger proof of this view of the Indian flax and linseed industry may be drawn from *Milburns' Oriental Commerce.* The first edition of that work appeared in 1813, but neither flax nor linseed are even mentioned in it by name. In the second edition, 1825 (issued by Mr. T. Thornton), it is stated,

* The italics have been given by the Editor of this work.

Flax and Linseed. (*G. Watt.*) **LINUM usitatissimum.**

"Flax is very generally cultivated in Bengal and Behar for the oil which is obtained from the seeds, the stalks being rejected as useless." It may be here added that Dr. Buchanan-Hamilton's silence on the subject of flax or linseed is also very significant and strongly confirmatory of the suggestion here offered, that in India down to about the year 1830, neither of these substances were of commercial importance, and, in fact, could hardly be said to have been Indian agricultural products.

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Buchanan-Hamilton, in his account of the Kingdom of Nepál, deals with the crops grown there in his time (1819), but makes no mention of Linseed. And what is even more remarkable he is silent on that subject, in his Statistical Account of Dinajpur, in Behar and also in his Journey through Mysore. The writer has repeatedly urged, in this work, that the mere existence of Sanskrit names, which by present universal admission allude to a certain plant, should not unreservedly be accepted, as DeCandolle very frequently does, to prove ancient cultivation in India. The names may be, as is doubtless frequently the case, comparatively modern adaptations, or they may denote, on the part of the early Sanskrit writers, a knowledge, or survival of a knowledge, that dates prior to their invasion of India.

Royle informs us that the first record of the exportation of Linseed from India occurs in 1832, when a Mr. Hodgkinson sent from Calcutta ten bushels. In 1860-61 the exports from India were 550,700 cwt., valued at ₹1,25,57,790; in 1880-81 5,997,172 cwt., valued at ₹3,69,81,265; and last year (1888-89) they were 8,461,374 cwt., valued at ₹5,05,79,221. Commenting on the Linseed trade of India, Mr. J. E. O'Conor points out that, in 1884-85, the figures of the export trade of Linseed during the five previous years showed an increase from 5,997,172 cwt. in 1880-81 to 8,746,596 cwt. in 1884-85, or nearly 46 per cent. In the succeeding year the exports reached their highest recorded extent, namely, 9,510,139 cwt. A diversion of the trade (Mr. O'Conor pointed out) from Calcutta to Bombay was striking. In 1880-81 Calcutta exported 4,065,341 cwt., and Bombay only 1,925,524 cwt.; whereas in 1884-85 they exported 3,757,018 cwt. and 4,989,578 cwt. respectively. This apparent migration does not, however, appear to have been maintained. Since last year (1888-89) Calcutta exported 5,659,492, and Bombay 2,797,246 cwt. For further particulars regarding the trade in linseed, the reader is referred to the section below which deals specially with that subject. (*Conf.* with the concluding paragraph of Trade.)

Properties and Uses.

FIBRE.

Fibre.—The bast fibres of the stems yield FLAX which when bleached is known as LINEN.

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Linen. ☞ 388

OIL.

Oil.—The OIL—LINSEED—is extensively used in the manufacture of paint, printing-ink, floor-cloth, artificial India rubber, oil varnish, and soft soap. The seed is nearly always adulterated, pure Linseed oil being in India almost unknown. In Russia it is adulterated with hemp seed, and in India being grown as a mixed crop with rape, it is rarely if ever pure. The OIL-CAKE is also an important article of trade and is both exported and sold in India as cattle food.

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Oil-cake. ☞ 390

MEDICINE.

Medicine.—LINSEED is used for poultices. It is also taken internally in bronchial affections, diarrhœa, &c. LINSEED OIL is aperient, but is only rarely administered internally. It is chiefly employed in the preparation of liniment for burns. It has been thought unnecessary to deal with all the minor uses of so well known a substance as Linseed oil. The reader is referred to the Pharmacopœia and such other works for information of that nature.

Linseed. ☞ 391

Linseed oil. ☞ 392

Seeds. ☞ 393

Flowers. ☞ 394

SPECIAL OPINIONS.—§ "The SEEDS are used internally for gonorrhœa and irritation of the genito-urinary system. The FLOWERS are considered a

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cardiac tonic" (*Dr. Emerson*). "Decoction of it used extensively in charitable hospitals for gonorrhœa" (*Civil Surgeon S. M. Shircore, Moorshedabad*). "The seeds after being boiled are strained off, and the liquid used with great benefit in irritation of the genito-urinary passages" (*Honorary Surgeon E. A. Morris, Tranquebar*). "The seeds powdered and combined with sugar are useful as an aphrodisiac and in gonorrhœa. The oil is used as an article of diet in the country about Nagpur, its purgative properties not being perceptible" (*Narain Misser, Hoshangabad, Central Provinces*).

FOOD. Seeds. 395 ☞

Oil. 396 ☞3 Linseed Oil-cake. 397 ☞9

FIBRE. 398 ☞

Food.—In many parts of India the SEEDS are eaten, especially those of the white form. In the passages quoted below frequent mention will be found of the various methods of preparing these seeds as an article of human diet so that the subject need not be here dealt with. The OIL is very little used in India, hence the amount of cake available for cattle food is but small; the oil seed is exported. To a certain extent, however, LINSEED CAKE is used as a cattle food, and, in some parts of the country, it is purified and eaten as an article of human food also.

FLAX—THE FIBRE OF LINUM.

Messrs Cross, Bevan & King, in their Report on Indian Fibres and Fibrous substances shown at the Colonial and Indian Exhibition of 1886, say that the bast of **Linum usitatissimum** "forms a continuous ring, that sometimes two concentric fibrous zones are developed, the fibres in which have different features. In many cases, an aggregation into two groups is noticed. The fibres are in loose contact, the cortical parenchyma not largely developed" The average number of fibres in the bundle they found to be 5-10, and these were discovered to be easily sub-divisible; length 25-40 mm. They, however, noted that there were two types—*1st*, the normal, of small diameter, thick-walled, and polygonal; *2nd*, large, ovoid, with a considerable cavity resembling that in rhea. Messrs. Cross, Bevan & King seem, however, to have examined only English grown flax: they remark of India:—"The stems do not appear to develop the fibre, and in no part of India is the plant specially cultivated as a source of flax. Whether this is due to abundance of other fibres discouraging any effort to produce flax, or to the climate of India favouring the development of the oil at the expense of the fibre, or simply to the peculiar variety cultivated, being an oil and not a fibre-yielding form, does not appear to have been practically solved. We should be glad of an opportunity to thoroughly investigate this matter, and, with the approval and co-operation of the Government of India, would propose to procure a quantity of the best flax-yielding seed from two or three European countries. This we should simultaneously cultivate, half in India and half in Europe. If the Indian samples were cultivated and carefully reported on, according to a plan agreed upon, the produce would enable us to form some definite ideas. At the same time, it would be necessary to have selected samples of Indian linseed cultivated alongside of the European, both in India and in Europe. From such experiments we would be in a position to judge whether it was the effect of the climate, or defect of the form of linseed cultivated, that rendered the rejected stems of the Indian oil-yielding plant valueless as a source of flax.

"At the late Colonial and Indian Exhibition, numerous inquiries were made as to whether India could not be induced to cultivate flax. The large, bold linseed was much admired, especially the white form, and several flax spinners solicited and obtained samples of the Indian seed from a conviction that it was some defect in the cultivation that prevented the Indian plant from yielding a very superior flax. It was universally admitted that

Flax. (*G. Watt.*) LINUM usitatissimum.

FIBRE.

the time had now come for the English flax-spinners to seek a new source of supply, or some good substitute for flax

"While venturing to make the suggestion that experiments might be instituted on the subject of flax cultivation in India, we are fully aware that such experiments were performed from the beginning of the century down to about 1850. It is presumed, however, that the immense advances which have since taken place have prepared the way for the subject deserving renewed efforts. We are confident that, just as with hemp, so with flax, the remarkable progression of the jute trade hindered the establishment and growth of a flax industry. It is the opinion of most experts that a re-action has now set in, and that the demand for textiles of all kinds would justify a fresh effort being put forth. Moreover, it is presumed that the success of the wheat trade has abundantly demonstrated what may be done in India towards cultivating during the cold months crops peculiar to Northern Europe. The experiments made with flax some half a century ago were chiefly in Bengal, whereas the more natural regions would appear to be some parts of Behar, the Central Provinces, or Bombay and the Panjáb. That flax can be produced in India was demonstrated beyond all doubt (although it is probable that the fibre-yielding plant would be found to be of little or no value as a source of the oilseed); indeed, so successful were the early experimenters, that in a letter, dated November 22nd, 1841, the Government of India refused to afford any official assistance, because 'the cultivation of flax can no longer be considered a doubtful experiment since it appears from your (Agri-Horticultural Society's) report to have proved in many instances successful, and where successful, to be very fairly profitable. In spite of this apparently hopeful position, the cultivation of flax was discontinued in India shortly after; but, be it observed, that this was the very period at which jute cultivation was making rapid strides.'"

It will be seen (from the pages below) that to some extent the experiments proposed by Messrs. Cross, Bevan & King have already been performed. Much time and money have at least been expended in the effort to make India a flax-producing country, but while good results have here and there been obtained, as, for example, in the Panjáb, the much to be desired object has not been attained. It seems probable that the indifference of the cultivators to their own better interests when these are only to be secured by departures from their time-honoured methods of agriculture, combined with the difficulty of preparing the fibre in a mercantile form, are greater obstacles than physical peculiarities due to the Indian climate or soil. The proposals of Messrs. Cross, Bevan & King are, however, worthy of careful consideration, since, if carried out, they would be of great value in determining where these physical peculiarities amount to an obstacle against hopeful results. They would, in other words, indicate where the effort should, or should not, in the future be made, to conquer the obstructionist policy that existed, and exists now with almost greater power than at the beginning of the century, since the experiments then performed resulted in a disappointing record of failure. Before concluding these introductory remarks regarding flax, it may be as well to quote here a fuller account of the microscopal and chemical nature of the fibre than the above. In Spons' *Encyclopædia* it is stated that "of all the vegetable fibres, flax occurs in the greatest variety, as regards the length of the filaments, their colour, fineness, and strength; but the fibrous bundle always retains the character of being very readily divisible into its distinct filaments, by rubbing it between the fingers; it then becomes soft and extremely supple, while preserving a great tenacity." On account of repeated bending, the fibres are seen under the microscope to have X-like creases. Under the action of

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iodine they assume a transparent blue colour, the creases taking a darker shade. "The dimensions of the fibres are as follows: length, 0·157 inch to 2·598 inch; mean, about 1 inch; diameter, 0·0006 to 0·00148 inch; mean, about 0·001 inch. The chief characteristics of flax are its length, fineness, solidity, and suppleness. Its remarkable tenacity is due to the fibrous texture and thickness of the walls; its suppleness permits it to be bent sharply; its length is invaluable in spinning; and the nature of the surface prevents the fibres from slipping on each other, and contributes to the durability of fabrics made with them. Flax may be made lustrous like silk, by washing in warm water, slightly acidulated with sulphuric acid, then passing through bichromate of potash vapour, and gently washing in cold water. Samples of flax exposed for two hours to steam at two atmospheres, boiled in water for three hours, and again steamed for four hours, lost only 3·5 per cent. of their weight, while Manilla hemp lost 6·07; hemp, 6·18 to 8·44; jute, and 21·39."

Messrs. Cross, Bevan & King (in their report already quoted) give the results of their chemical analysis. In the article on Marsdenia tenacissima (see Vol. V, 189) the chemical nature of flax has been compared with four other fibres. The table there given may, therefore, be consulted, but it may briefly be said that flax was found by the above-mentioned chemists to possess 9·3 per cent. of moisture and 1·6 per cent. of ash. Under hydrolysis for five minutes it lost 14·6, after an hour 22·2 per cent. Of celluloses (one of the best tests for fibres) it was seen to have 81·9 per cent. By mercerising it lost 8·4 per cent. and by nitration gained, becoming 123·0 per cent. By acid purification it lost 4·5 per cent. and was found to yield 43·0 per cent. of carbon. The fibre experimented with was, as already stated, European flax, so that a comparison of the Indian fibre, with the above results, might be viewed as indicating the influence exercised by the Indian climate, soil, and method of cultivation, on the production of fibre, or might even demonstrate to what extent a plant cultivated for at least several centuries as a source of oil, was still capable of being utilized in the production of fibre.

CULTIVATION.

CULTIVATION OF FLAX.

Early experiments.

EARLY EXPERIMENTS IN INDIA.

The Government of India having procured on loan from the Board of Trade, Calcutta, the Proceedings of the Hon'ble the East India Company which contain the record of the early experiments in the cultivation of Flax, the writer found (after carefully reading through these curious manuscript volumes) that there was little more to be learned than had been published by Roxburgh, Carey, Wisset, Royle, and other authors whose works have long been in the hands of the public. The first experiments were performed between the years 1790 and 1799, and a further series of trials were again instituted about fifteen years later. The results were the same, though attended with a certain degree of success in the hands of the European expert cultivators, who at considerable cost were brought out for the purpose to India, the cultivation of flax did not extend from the Government farms to the fields of the agriculturists. In time the whole subject was thus allowed to lapse into absolute obscurity, the interest in both flax and hemp being extinguished through the commercial progression of India in other and more hopeful directions, *e.g.*, jute, which in time practically took the place of flax and hemp in popular favour.

There is thus little more to be said than is contained in Royle's work on Fibrous Plants, until the record be carried some forty or fifty years nearer the present date. Space will not admit of a reprint of Royle's article on Flax in its entirety, but since that work is not so accessible as its great value

deserves, the following pages (up to page 24) which convey the main facts of practical interest, may be given :—

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"REPORT ON THE CULTURE OF FLAX IN INDIA.

"India having, at least, for centuries grown the Flax plant, on account of the oil yielded by its seeds (Linseed), the country has very naturally been looked to as a source of Flax fibre, the supply of which is so greatly diminished by the war with Russia.* The Belfast Chamber observe that 'as India annually exports nearly 100,000 quarters † of seed to Great Britain and Ireland, it has been calculated that the plants which produced this quantity of seed would yield, annually, at least 12,000 tons of fibre—value, say £500,000, all of which now goes to waste.' Besides the above quantity of seed, much is also exported to North America and to other countries, and much is consumed in the country in the form of oil, while the cake is in some places employed in feeding cattle. There can be no doubt, therefore, that the question is one of considerable importance, not only to this country, which requires such immense quantities of Flax fibre, but to India, which produces such enormous heaps of seeds, and is supposed to waste so much of valuable exportable material. But it does not follow that the production of fibre is in proportion to that of seed. Indeed, we have often to check vegetation in order to favour the production of flowers and fruit; while an undue growth of the parts of vegetation, that is, of the stem, branches, and leaves, is often obtained at the expense of the parts of fructification. The subject, however, has not escaped notice.

"The earliest attempt to produce Flax in India seems to have been made by Dr. Roxburgh about the beginning of this century, and as at that time the East India Company had established a Hemp farm in the neighbourhood of Calcutta, he was able to make many experiments on substitutes for Hemp and Flax. He also cultivated Hemp and Flax in the Company's farm at Reshera, in the neighbourhood of Calcutta.

"Of Flax, he says, it is very generally cultivated during the cold season in the interior parts of Bengal and Behar. 'Samples of the Flax have frequently been procured by the Board of Trade, and sent to England to the Honourable Court of Directors, so that it is from home we may expect to learn its properties. If the Flax has been found good, large quantities may be reared at a small expense, as the seed alone which the crop yields must be more than equal to the charges to render it profitable to the farmer' (*'Obs. on Subs. for Hemp and Flax,' p. 171*).

"The Author, as long since as the year 1834, stated in his '*Illustrations of Himalayan Botany*: 'In India the Flax is cultivated only on account of its seed, of which the mucilage is valued as a demulcent, in medicine, and the oil in the arts; but the plant, which in other countries is most valued, is there thrown away; and others, such as **Hibiscus cannabinus** and **Crotolaria juncea**, are cultivated almost in the same field for the very products which this would yield. It seems, therefore, worthy, of experiment whether a valuable product might not be added to the agriculturist's profits, without much additional expense.' And again, in the year 1840, the Author called attention to this subject in his *Essay on the Productive Resources of India*.

"In the year 1839, moreover, a Company was established, by the influence of Mr. A. Rogers, at one time one of the Sheriffs of London, expressly for the growth of Flax in India. Money was subscribed; a Belgian cultivator and a Belgian preparer of Flax were sent out to Bengal, with both Riga and Dutch seed, and all the tools which are employed in the culture and preparation of Flax in Europe. A pamphlet moreover was published, in which full directions were given for the culture and preparation of Flax, and illustrated with figures of the various tools employed for this purpose. The subject was warmly taken up by the Agricultural Society of India, and a small committee appointed of members who took a special interest in the subject.

"The directions of the Irish Flax Society were printed in their *Proceedings* as well as those of Mr. Andrews from the *Northern Whig*. Translations of plain directions were made into the vernacular languages, which, as well as models of the tools, were distributed. The Gold Medal of the Society was offered for the production of a large quantity of Flax, and smaller prizes for the natives. Experiments were made by several members of the Society, in different parts of the Bengal Presidency, as well as by the Belgian farmers.

* The following formed the substance of a report prepared by Dr. Royle in August 1854, and is printed nearly as it was written.

† [See the present trade in Linseed, in the Chapter on that subject.— *Ed.*]

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"Specimens of the Flax produced having been sent to Calcutta, comparisons were instituted between the samples produced by different individuals, and those from European and from indigenous seed. Mr. Deneef, the Belgian farmer, pronounced the samples worth from £44 to £60 a ton; and one, produced from country seed and heckled, was thought worth £66 a ton. Some of the specimens sent to Liverpool were valued at from £30 to £45; and those which were forwarded to me by the Secretary of the Agricultural Society were pronounced by Mr. Hutchinson, of Mark Lane, to be worth from £40 to £45 a ton. The experiments were made chiefly near Burdwan, Monghyr, and Shahabad; but the best native seed was obtained from the northern station of Saharunpore, and a white Linseed from the Sangur and Nerbuddah territories. A little Flax was also produced by Mr. Williams, at Jubbulpore, under the direction of Mr. Macleod.

"Mr. Leyburn gave as the result of his experiments near Shahabad, that the expenses of culture of a bigha of land, and the preparation of the fibre, amounted to R25-1-3; and the profits to R27-1-5, supposing the four maunds of Flax produced to be worth £35 a ton.

"In consequence of a communication which had been received from the Honourable Court of Directors, Sir T. H. Maddock, at that time Secretary to the Government of India, addressed a letter to the Agri.-Horticultural Society. In this the Society was requested, in order to assist the Government in determining on the measures proper to be adopted for improving the cultivation of Flax, to supply such accurate, detailed information as they may possess, or as they may be able to obtain.

"The Society accordingly prepared a report which contained everything that was known at that time on the subject of the cultivation of Flax in India. This was forwarded to the Government, and also published in their 'Proceedings' for November 1841. In this report, the Society took a very favourable view of the probabilities of the profitable culture of Flax in India.

"The Revenue Secretary to the Indian Government, on this, wrote (November 22nd, 1841) to the Agricultural Society, that—'The cultivation of Flax can no longer be considered a doubtful experiment, since it appears from your report to have proved in many instances successful; and where successful, to be very fairly profitable. His Lordship in Council is therefore much inclined to doubt whether any bounty or reward from Government is necessary, or would be justifiable.'

"Notwithstanding this favourable inference, the Flax Company did not go on with the cultivation; the various individuals who had taken up the culture did not proceed with their experiments; the several medals offered by the Agricultural Society seem never to have been claimed, and there are no appearances of the culture of Flax on account of its fibre in any of the places where the experiments were made. It is probable, therefore, that the success, which appeared sufficient when the experiment was of the nature of garden culture, was not realised when on a greater scale.

M. de Verinne, indeed, states that the experiment in the season of 1840-41 was a complete failure at Bullea, owing to too little seed having been sown, to the unusually dry weather at the late sowings, and to the improper time (the hot winds) in which the Flax was cleaned.

"Mr. Wallace, who had carried on the cultivation for three or four years at Monghyr, writes on the 8th July 1841: 'The crop has been in a great measure a failure this year About one-eighth of the produce that a favourable season would yield.' But in the year 1844, he again forwarded samples to the Agricultural Society, which were improved in cleanness and were also softer than the produce of former years, from the same cultivation. These were portions of several tons that had been grown at Monghyr, and which he intended shipping to Dundee, the port to which his last batch was sent. But Mr. Wallace, added, with regret, that after several years' labour, with a view to establish Flax cultivation at Monghyr, and after having taught the art of dressing the article to many parties, the speculation must be abandoned, unless the Government gave some encouragement. He therefore requested the assistance of the Society in bringing the subject to the notice of the authorities. It is stated at a subsequent meeting that the Committee of the Society, after being furnished with further details respecting the cultivation, did not feel inclined to refer the subject to the Government. But neither the details referred to nor the reasons of the Committee for their decision are given, and, therefore, we are unable to ascertain the real causes of failure after several years' trial.

"Mr. Henley, an intelligent merchant from Calcutta, having made some careful experiments on the culture of Flax, has favoured me with the following account:—

"'I have paid much attention to the fibres during my residence near Calcutta, and, not wishing to conclude from hearsay only, generally cultivated most things myself, having a large piece of ground available. I sent up to Baugulpore (an excel-

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lent Flax seed district), and obtained a considerable quantity of native grown Flax straw, after the removal of the seed. I had it collected from various fields, so as to obtain an average. This material was in every instance too *bushy* for the proper production of fibre, and the yield was very trifling, and in fact worthless for manufacturing purposes. The bushiness arose from the practice of the natives, who grow several plants, as you are aware, at once, in the same field. The Flax plants were consequently planted too far apart for fibre-yielding purposes.

"'Not yet fully satisfied on the question, I took a patch of land (three *cottahs*), the best I could pick out, fine, friable loam, fit for anything—it had been a cauliflower bed, and was therefore deeply spade-cultivated and highly manured—its last crop, cauliflowers, having nothing prejudicial to a Flax crop. I began very early in the season, had it turned up and laid for a fallow; two months after, again pulverized and weeded, and again—four times in all; with the addition of a large supply of fine old cow-dung. I had it now sown in the proper season, with the best Flax seed, very thickly planted, so as to draw it up as free as possible from lateral branches. Everything promised well. The field grew beautifully, and soon attained a height of three feet. I began to collect the crop, first, as soon as the flower had completed its growth and the seed-vessels began to form; secondly, as soon as the seed-vessels had fully formed and were filled with green but immature seeds; and lastly, after the seed was fully ripe. I took great pains in water-retting the samples—generally removing them from the water rather under-done, for fear of occasioning weakness in the fibre from over-retting.

"'In every instance, the quantity of fibre was small and weak, and very inferior to the samples of Flax deposited at the Agricultural Society's Museum, obtained from Jubbulpore, and other upper country districts. No Indian Flax, however, which I have seen, equals in nerve and general good qualities those of European growths.'

"As the above is no doubt a correct account of what occurs with the Flax plant in the moist climate of Bengal, of which the effects may perhaps have been aggravated by too great richness of soil, it might be inferred that a different result would take place in the drier climate of the upper or North-West Provinces of India. This is certainly the case, but though the product is different, it is not, from the shortness and brittle nature of the fibre, more suitable for the ordinary purposes of Flax.

Mr. Hamilton, of Mirzapore, one of the up-country stations alluded to, 'sent some bales of the stalks to Calcutta, for the inspection of the Belgians, and was told that the shortness of the stalks would prevent their manipulation.'

"It is evident, therefore, that there is some difficulty in producing good Flax in India. This difficulty is, no doubt, the climate; while the native methods of culture are the most unsuited to the production of good fibre. Mr. M'Adam, Secretary to the Royal Flax Improvement Society, has, in his Prize Essay on *The Cultivation of Flax*, well observed 'that a slow, steady growth is requisite for the quality and yield of fibre; also a temperate climate, that between the parallels of 48° and 55° being the best; and a continued supply of moisture from spring till autumn.' He also observes that 'the hot summers of Russia and of Egypt cause a dryness and brittleness of fibre, and prevent its retaining that elasticity, pliancy, and oiliness which characterise the Flaxes of Belgium, Holland, and Ireland.'

"But considered generally, it is not to be expected that a plant which attains perfection in Belgium, and is so successfully cultivated in the vicinity of Belfast, would succeed well in the hot and moist, but sometimes dry climate of Bengal. In fact, if the Flax was not one of those plants which, like the cereal grains and pulses, can be grown in the cold-weather months of India, it could not be cultivated there at all. But with this culture, we have the anomaly, of the seeds being sown in autumn, * when the climate is still hot and the ground moist, and the plant has to grow while the temperature is daily becoming lower and the soil drier—no irrigation being usually employed with these winter crops, though dew begins to fall as soon as the ground becomes cooled at night. In some places, the crop attains perfection in about ninety days, is collected in January, the coldest month; in others, not until February or March, when the rapid rise of temperature is favourable to the ripening of seeds, but not to the production of fibre.

"Of all parts of India there are none that appear to me better suited to the growth of Flax than the Saugur and Nerbuddah territories, where the soil is rich and prolific, and the climate a medium between the extreme moisture of Bengal and the dryness of the North-West Provinces. The Wheat of this district is considered superior to any seen in the English market, with the exception of what comes from Australia.

* In Egypt, also, the seeds are sown about the middle of November, in the plains which have been inundated by the Nile, and plucked in about 110 days.

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The Gram and the Linseed are also of finer quality than any produced elsewhere in India; while the suitableness of the climate for the production of good fibre is proved by the length and strength of the Jubbulpore Hemp, as grown by Mr. William as well as by the specimens of Flax which he has likewise grown.

"The Indian method of culture is certainly not suited to the production of fibre, but the seeds abound in oil. 'The yield of oil from a bushel of Indian seed is from 14¾lb to 16lb; of English or Irish, 10¾lb to 12lb.' Therefore, it is evident that the Indan ryot succeeds in his object, as well as the Irish farmer, who grows the Flax plant for its fibre, but neglects to gather the seed: though this is not only a saleable product, but one which abounds in nutritious matter for his cattle, and would further afford the means of fertilising his fields. As it has been found difficult to persuade the Irish farmer to gather the double crop, I believe it would be hopeless to induce the Indian ryot to change a culture which is suitable for his purposes, without the aid of successful example in his neighbourhood. You might make him grow less seed, but I much doubt whether we should get him to produce any useful fibre; and without his co-operation it would be impossible to attain any considerable success. Indeed, the Agricultural Society of India have given it as their opinion, in one of their resolutions,—'That the culture and preparation of Flax in India, so as to be able to compete with the Flax of Belgium or Russia, can only be effected by practical European growers instructing native cultivators in the art; and, further, that an entire change in the mode of cultivation, as well as in the preparation of the plant, is necessary to produce the article in a proper state.'

"It has, indeed, been made a question, whether a good supply of fibre and of seed can be procured from the same crop. One gentleman, in reply to my inquiry, informed me (London, 4th July) that 'it has been found impossible to preserve both seed and fibre, *i.e.*, for the better qualities of each; and that the plan pursued is simply to gather before the seed ripens, when the delicacy and softness of fibre form the desideratum, but to leave the plant standing until the fibre is dried and greatly injured, in order to secure the superior seed fit for sowing;' and this is the result of information collected after a residence of many years in the interior of Russia. Another gentleman replies to the same inquiry, from Belfast, on the 8th July: 'It is not only quite practicable to have good seed and good fibre at the same time, but it is the universal rule in all countries except Ireland, where we have only been able to get the more intelligent farmer to abandon the wasteful practice of steeping the Flax stems without removing the seed. The finest Flax in the world is grown in Belgium, yet the seed is saved from it.'

"But as there is no doubt, from the experiments of the Indian Flax Company, and from other more recent facts, such as the production of Flax as far sonth as on the Shevaroy Hills, at Jubbulpore, and near Lahore, that Flax can be produced in India, it seems desirable to ascertain whether it cannot, by careful culture and improved processes, be produced as a profitable crop in some parts of the country; because, as I have before said, 'I cannot think that that which is done successfully in Egypt, is impossible in every part of India;' and there can be little doubt that, in some places, at least, coarse Flax could be produced, as well as some for the paper-makers.

"I am informed that Messrs. Hamilton, of Mirzapore, propose, this year, attempting the culture of Flax, in the tract of land of which they have a grant, in the Goruckpore district, and which I should consider a more favourable locality than any near Mirazpore. I would suggest that Mr. Williams, at Jubbulpore, should be requested to make an experiment, to ascertain the quality of the Flax which may be produced in that locality, as well as the quantity obtainable per bigha or acre, attempting at the same time to preserve the seed. Mr. Williams has already grown a little Flax; he is accustomed to the preparation of fibre, and the soil and climate are both, I conceive, more favourable than in most parts of India.

"I would also recommend that Dr. Jameson, the Superintendent of the Botanic Garden at Saharunpore, should be directed to make a small experiment, both in the plains and in the hills, in order to ascertain the same kind of facts respecting the Flax plant when grown according to European methods for the sake of the fibre. The Agricultural Society of the Panjáb are already attempting the culture, as the Secretary has addressed a letter to the Court, requesting an opinion respecting the quality of the Flax which they have already produced; but the specimens have not yet arrived. (Further information has, however, recently been received, and will be afterwards detailed.)

"Though I am well aware that Government experiments are not likely to prove profitable where those undertaken by individuals have failed, especially as these had

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good scientific and practical advice, I am yet sanguine in thinking that experiments conducted in the localities I have indicated would give information which would be practically of great value for extensive tracts of country. The people are acquainted with the culture and preparation of *Sunn* fibre, and might easily be instructed by the European gentlemen to whom I have alluded, in applying the instructions for the culture of Flax in the *Proceedings of the Agricultural Society of India* for the years 1840 and 1841, including those prepared by Mr. Deneef, the Belgian farmer, after practical experience in India, published first in 1840, and then in 1842.

"I have not thought it necessary to refer to the opinions respecting the exhausting nature of Flax as a crop. By the methods of steeping the stalks in steam and hot water, it has been ascertained that the time required for the separation of fibre can be very greatly reduced; while the steep-water, where no fermentation has taken place, has been proved to be useful as manure water for the soil. Feeding cattle, moreover, upon a portion of the seed, produces manure which is invaluable in restoring much of what has been taken from the soil. But as these methods are not applicable to the present state of the culture in India, I will only allude to the probability of some of the mechanical methods of separating the fibre from the green flax, proving likely to be of useful application.

"Since, according to some accounts, considerable success attended the experimental culture of Flax in India, while others considered it a failure, it is desirable to ascertain the causes of this discrepancy, and to draw some conclusions which may be of use to other parts of India, if not to the places where the experiments were made. This we may probably effect, by analysing the statements of the different experimentalists.

"*Shahabad Experiments.*

"The cultivation of Flax in India in recent times seems to have begun at Shahabad, in 25° of north latitude, in the year 1837. In the *Proc. of the Agri.-Hortic. Society*, there is a communication from Mr. G. Leyburn, of Nunnoa Factory, giving an account of the sale in London, on 17th July 1838, of some Flax grown by him. 'The Flax, per *Windsor*, is landed sound. No. 1 sold for £28 per ton, and No. 2 for £14 per ton—nine months' credit. They are described as harsh, and without the softness characteristic of Russian Flax. Prices of the latter being lower than usual, P. T. R. selling here at this time at £40 per ton.'

"Mr. Leyburn states that he prepared his first sample of Flax in the common way, from plants which had borne seed. He sent them to Messrs. Truman and Cook who reported that any quantity of a similar article would find a ready sale, at £35 a ton. In the following year, Mr. Leyburn entered on the cultivation rather extensively, and succeeded in producing an article of lengthened staple, and of a quality vieing with the Flax of Russia. A portion of the cultivation was carried on in the bed of the Soane River, and part in the uplands of the district: some of it was prepared before the seeds were ripe. He calculates the probable profits of the culture to be:—

Per bigha.*	₹	a.	p.	Produce.	₹	a.	p.
Rent of land	1	8	0	Linseed, 5½ mds.	5	8	0
Ploughing	0	8	0	Flax, 4 mds., at (say) £35 per ton	46	10	8
Seed	1	8	0		52	2	8
Pulling, beating seed off, watering	5	9	3	Deduct expense of cultivation, as per contra	25	1	3
Packing, cartage, preparation (nearly all hand labour)	16	0	0				
Total	25	1	3	Profit on one bigha of land	27	1	5

"With a factory in full play and effective machinery, Mr. Leyburn considers that the manufacturing price of the article would be three to four rupees a maund, which is equal to about £9 or £12 a ton. But to give effect to the production of this article, the aid of European enterprise is necessary. (It is particularly deserving the attention of indigo-planters.) He failed in overcoming the deep-rooted prejudices

* The bigha of land in Shahabad is something more than the Bengal bigha, which is 1,600 square yards, or the third of an English acre.

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of the native cultivators, and could not induce them to enter on a cultivation which held out to them a prospect of more than ordinary profit for their labour.*

"Experiments of the Flax Society.

"We may now proceed to notice the efforts of the London Flax Experimental Society. Mr. Woollaston, in presenting, on their behalf, some specimens of Flax grown in Bengal, and prepared in Calcutta, observed that—

"'The object of the Society is not at this time to produce a large quantity, but to ascertain how good a quality can be readily obtained, the growth of India, and such as shall readily compete with the Russian and Belgian Flax in the Home market. This object has been already attained to a considerable extent. These samples far surpass the Russian Flax,' and he regretted that 'the Government of India have not responded to the recommendation of the Horticultural Society in granting a bonus to the Experimental Society of 10,000 rupees to further its objects.'

"'The seed received from England, Mr. Woollaston further remarks, has been distributed freely to all applicants who were desirous of trying the cultivation. The models of implements were sent out from Belgium, and facsimiles made for any person requiring them at the *bonâ fide* cost of the materials. Private profit or gain has never been allowed to interfere. Every kind of information, as far as possessed, has been freely imparted to all inquirers, and every endeavour made to excite an interest in the experiment.

"'Its importance in a national point of view is incalculable. Both as developing the resources of India, in enabling England to supply herself from her own possessions in a most important raw material, and in no longer making her dependent, for what may well be considered necessaries, upon a foreign and rival power. These observations, Mr. Woollaston considers, will apply in a great measure to Hemp also, in the cultivation and manufacture of which the Experimental Society are deeply interested. The successful introduction of these two staples into England, from this country, will not only prove a blessing of the largest degree to *India* generally, but be a severer blow to Russian aggrandisement and encroachment than the destruction of her fleets, or the annihilation of her armies.'

"The Agri-Horticultural Society having recommended that the bonus of R10,000 should be given for the furtherance of the objects of the Flax Society, Lord Auckland, who was at that time Governor General of India and was as warmly interested as any one in the improvement of its resources, was also a political economist: the Secretary to Government was directed to reply:

"'His Lordship cannot but regard with interest the public-spirited proceedings of the gentlemen who have come forward to promote the improvement of the cultivation of Flax in India, but it is only in very rare instances, and with the view of exciting a direct and general competition, that he would attempt by encouragement or bounty to influence the course of commercial and agricultural enterprise, and he does not feel that the case before him is one which would justify the special interference of the Government.'

"Mr. Deneef, the Belgian farmer, and Mr. Bernard, the preparer of Flax who had been sent to India by the Society, were of great use in examining the soil and giving directions on the mode of culture best adapted to the country, as well as in reporting on the different samples of Flax which were grown in the country. Mr. Deneef's directions for the cultivation of Flax, drawn up after he had had practical experience in the country, remain as a valuable document for the guidance of others. These we, therefore, reprint from the *Journal of the Agri.-Horticultural Society* for the year 1842, p. 393.

"PRACTICAL INFORMATION ON THE BEST MODE OF CULTIVATING FLAX IN BENGAL. BY MR. DENEEF, BELGIAN FARMER.

"'In accordance with my promise, I send you as follows, a detailed report of my observations since my arrival in India, on the cultivation of the Flax plant.

"'I will not enter on an explanation of the mode adopted in the cultivation of this plant in Europe, because nothing is easier than to do so theoretically, but will content myself with informing you, from my own practical experiments, of the means

* M. Bonnevie, indigo-planter at Rungpore, writes: "Having great difficulty to prevail on these ignorant cultivators to plant it—owing to a superstitious belief that the vengeance of an evil spirit will befall them for introducing the cultivation of a new article. Flax grows remarkably well here, and I have no doubt would succeed well in this district. The Zemindars now commence to show an inclination to improve agriculture in general."

Cultivating Flax. (*G. Watt.*) LINUM usitatissimum

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at our disposal in this country, which can r adily be made available for the production of Flax and its seed:

"'1. Such portions of land as are annually renewed by the overflowing of the Ganges, or which are fresh and ricn, are the best adapted for the cultivation of Flax.

"'2. After the earth has been turned up twice or thrice with the Indian plough, it must be rolled: because without the aid of the roller the large clods cannot be reduced, and the land rendered fine enough to receive the seed. The employment of the roller, both before and after sowing, hardens the surface of the earth, by which the moisture of the soil is better preserved, and more sheltered from the heat of the sun. About and near Calcutta, where manure can be obtained in great abundance for the trouble of collecting it, Flax may be produced of as good a quality as in any part of Europe. Manure is the mainspring of cultivation. It would certainly be the better, if the earth be well manured, to sow first of all, either *Sunn* (Indian Hemp), or Hemp, or Rice, or any other rainy-season crop; and when this has been reaped, then to sow the Flax. The tillage of the land, by means of the spade (*kodalee*) used by the natives (a method which is far preferable to the labour of the plough), with a little manure and watering at proper seasons, will yield double the produce obtainable from land tilled without manure and irrigation.

"'The mode of forming beds of six feet in width with intervening furrows, in use in Zealand and in Belgium, is very inconvenient in India, because great care must be taken to preserve the moisture of the soil; and on the other part, for the purpose of weeding, they are unnecessary. When proper Linseed, freed from mustard seed, is sown, I think that the Flax requires no weeding at all in India.

"'3. The proper time to sow the Flax in India is from the beginning of October until the 20th of November, according to the state of the soil. The culture must be performed, if possible, some time before the sowing. The Flax which I have sown in November was generally much finer and much longer than that sown in the former month, which I attributed to the greater fall of dew during the time it was growing. The quantity of country seed required to the Bengal *bigha* is twenty *seers*, but only fifteen *seers*, of the foreign seed, because it is much smaller and produces larger stalks. The latter should be preferred; it is not only more productive in Flax, but, owing to the tenderness of its stalks, it can be dressed much more easily.

"'4. The Flax must be pulled up by the roots before it is ripe, and while the outer bark is in a state of fusibility. This is easily known, by the lower part of the stalks becoming yellow; the fusion or disappearing of the outer bark is effected during the steeping, which may be fixed, according to the temperature; say, in December at six days, in January five, in February four days, and less time during the hot season. The steeping is made a day after the pulling, when the seed is separated, and then the stalks are loosely bound in small sheaves, in the same way as the *Sunn*. The Indians understand this business very well, but in taking the flax out of the water it should be handled softly and with great care, on account of the tenderness of its fibres. When it is newly taken out, it should be left on the side of the steeping pit for four hours, or until the draining of its water has ceased. It is then spread out with the root-ends even, turned once, and when dry it is fit for dressing or to be stapled.

"'5. To save the seed, the capsules, after they are separated from the stalks, should be put in heaps to ferment from twenty-four to thirty hours, and then dried slowly in the sun to acquire their ripeness.

"'6. When Flax is cultivated for the seed alone, the country Flax should be preferred. Six *seers* per *bigha* are sufficient for the sowing. It should be sown very early in October, and taken up a little before perfect ripeness, by its roots, separately, when it is mixed with mustard seed; the Flax seed being intended for the purpose of drying oil, is greatly injured by being mixed with mustard seed, by which mixture its drying qualities are much deteriorated. With regard to the dressing of the raw material, most of the coolies are now acquainted with the process, and I have not therefore alluded to it. Should you desire any further information on the subject, I am ready to afford it.'

"Mr. Deneef, in reply to some queries circulated by the Agri-Horticultural Society, observed that too dry or saline soils were injurious to the culture, but that his own had been a heavy clay soil; also, that the Bengal bigha contained 14,400 square feet, or one-third of an acre, and that he sowed of foreign seed 28lb; of American 36lb; but of plump Patna, or native seed, not less than 40lb, on account of its larger size. That the foreign seed cost R8 a maund of 82lb, while the native then cost R2-8.

"The acclimated American seed he found to succeed well in India. But on a previous occasion (Feb. 10, 1841), he had observed of some samples grown at Entally,

from acclimated English seed, from country seed, and some from Saharunpore seed, (from 30° of N lat.), that the sample from this last was very superior to the others. Of two samples from acclimated American seed, one grown in rather poor ground, the other in a rich soil—'The former,' he observed, 'is a most beautiful sample, containing great length of stalk with thinness; the other is of very little value, the goodness of the soil having caused the plant to become stunted and branchy.'

"Mr. Deneef further observed that he obtained the longest and finest fibres in sowing from the 25th of October to the 15th of November: this he ascribes to the plant being covered every morning with a heavy dew; while that which he had sown in the beginning of October, in the same soil and the same seed, was much shorter in stalks, but much more productive in seed,—'the rain being very scarce from the first days of October until the end of December, in this part of India.' (But the ground is still hot, and the temperature high at this period.) The bigha will yield 100lb of seed from foreign seed, and about 12 per cent. more from native seed.

"He concludes with an approximate account of the cost (amounting to £32) of raising a ton of Flax from Foreign seed, well dressed, and which would be worth £50 in the English market; stating that 80lb of Flax for a bigha of land is a very small product. 'When we shall be able to have the seed from our own product, R60 on that article will be saved.' The account is as follows:—

	R
30 bighas' rent for six months—the other six months for other crops	45
10 maunds of American or European seed, at R8	80
6 bighas of superior (spade) cultivation, at R5	30
24 bighas, four necessary ploughings, each R3	72
Sowing, malees, recolt, rippling, steeping, carrying, and petty expenses	48
28 maunds dressing, in a very clean way, at R3-8	98
Breaking of flax-tools	7
TOTAL	380

Return:—1 maund Flax.
19 to 20 maunds Seed.
7 to 9 Codilla.

"'*Chittagong Flax.*—One of the most southern districts in the Bengal Presidency where Flax has been prepared, is that of Chittagong. A. Sconce, Esq., at that time Collector of Chittagong, forwarded, in March, 1843, some samples of Flax which he had grown there from acclimated Europe seed; that is, from seed re-produced for two or three years from imported seed, and sown there in the month of November. He suggested to the Society the awarding of small prizes to natives who cultivated the Flax on account of its fibre. His object being 'to interest chiefly those who are familiar with the cultivation of Linseed (which is common enough for the purpose of extracting oil) and the country *Sunn*.' He states that he had had an opportunity of observing in that season the very great difference between Flax grown from Europe and from country seed—the latter being softer and finer, but very much shorter, and very much weaker. If this is found to be the case by others, the length might probably be easily increased by cultivation. The samples examined by the Flax and Hemp Committee were reported on as follow:—

"'*Undressed Flax.*—This sample contains more Tow than Flax; it is badly prepared, dirty, and not adapted for the Home market; but the

"'*Dressed Flax*—Strong, clean, of very superior quality, but of short staple: if it were a little longer, say six inches, it would realise a very high price in the Home and Continental markets. Mr. Deneef said of it that the staple, though short, was most beautiful; but the mode of preparation (having been hackled) is 'too expensive to admit of its yielding a profitable return, even were it to sell at the value I affix to it, *viz.* £60 a ton.'

"'*Burdwan Flax.*—Four samples of Flax grown at Burdwan were presented to the Agri.-Horticultural Society, by Mr. J. Erskine, in July 1844. Of these, Nos. 1, 3, and 4 were the produce of acclimated and up-country seed mixed together—sown in October and November 1843, and reaped in February and March 1844. No. 2 was the produce of up-country seed, sown on 15th October, and reaped on the 27th February. Mr. J. Law having examined these samples considered them all as of a fair quality; and, judging from the prices of the different marks of the article then in Britain, valued Nos. 1 and 2 at £32, No. 3 at £34, and No. 4 at £30 per ton, landed in England.

"*Bullea Experiments.*

"Mr de Verinne, Superintendent of Flax cultivation at Bullea (twelve miles below Benares), in reply to the queries, states, as already mentioned (September 20, 1841)

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that the experiment of the previous season had been a complete failure. He sowed 130 Duncanee bighas, each containing 28,336 square feet, double of the Bengal bigha. The soil was not manured, but ploughed seven and eight times. Somewhat sandy soils are the best. The hard soil which the natives select for growing Flax for the seed, remains in clods, and cannot be pulverized. He first sowed one maund of seed (from the Chupra district) per bigha. Mr. Bernard, one of the Belgian farmers, thought this too much; he reduced it to 20 seers, or 40lb., which proved too little, (and evidently so, as the same quantity is recommended by Mr. Deneef for the Bengal bigha, which is only half the size). He began sowing on the 16th of October, and concluded by the end of the month; the plant was ready for steeping on the 10th of February. He recommends sowing in the beginning of October, as there is moisture enough at the surface of the ground to sow broadcast. Early sowings, also, will in general do away with the necessity for irrigation, which is otherwise indispensable, and expensive. (But is not the greater heat both of the soil and of the sun more injurious than the greater dryness of the soil late in the season, when dew falls?) He states that from the 10th of September till the 20th of January, when the Flax was in seed, and had ceased growing, there was no rain. About fifty bighas were sown with drill-ploughs, because there was no moisture at the surface of the ground, but as Mr. Bernard disapproved of this mode, the rest was sown broadcast, when they were obliged to irrigate the land.

"The plants having been pulled by the 10th of February, and the seeds taken off, the stems were steeped in (indigo) vats. The first vat was steeped nine days; the second and third, ten days; and the fourth and fifth, eleven days, the weather having got cooler from the fall of a shower of rain. Range of thermometer, 60° to 70°. The plant for steeping was not perfectly ripe, but the small plants were left to ripen their seed.

"The crop was small, owing to the unfavourable season. Only 1 maund 25 seers of seed, and 70lb of Flax per bigha, while the Duncanee bigha ought to yield from 150 to 200lb of clean Flax.* The proportion of Flax to the Tow or Codilla varies according to the weather in which the Flax is cleaned; if prepared in the dry weather or hot winds, or from April to the end of June, the proportion is one-third Flax to two-thirds Tow; if prepared in damp weather, or from July to October, it is half to half. With regard to the cost, M. de Verinne says: 'Supposing the season to be an average one, and the produce of the bigha to be 150lb of clean Flax, 100 bighas would give 6¾ tons, and the cost, according to the annexed estimate, being R2,237, will show the cost per ton, landed in Calcutta, to be R331, or £33. In making up the estimate, I have calculated the expenses according to those of the experiment of last year. Only the produce has been valued at 150lb per bigha,' though 70lb only were obtained.

"Estimate of the probable expense for the cultivation of 100 bighas of plant, the manufacture, and the despatch of the produce to Calcutta—

	R	*a.*	*p.*
Land rent for 100 bighas, at R4-8	450	0	0
Irrigating the lands, if there is no moisture at the surface, at R1 per bigha	100	0	0
Six ploughings, at 4 annas each per bigah	150	0	0
Chikorage, or cleaning the fields before sowing, at 8 annas per bigha	50	0	0
150 maunds of seed, at R1-8 per maund	225	0	0
Plucking the plant, at R1 per bigha	100	0	0
Weeding, at 8 annas per bigha	50	0	0
Taking off the seed, at R1 per bigha	100	0	0
Filling the vats, taking the plant out, spreading and turning it, &c., at 12 annas per bigha	75	0	0
Breaking the flax for cleaning, at R1-4 per bigha	125	0	0
Cleaning the flax, at 2 annas per pound	468	12	0
Gunny bags, for bales	20	0	0
Making up the bales	14	0	0

* With these Indian returns of the produce per bigha (which is at Bullea two-thirds of an acre), we may contrast a statement by Dr. Hodges: "From the returns of the Royal Flax Society, and from my own inquiries, I would estimate the average produce of a statute acre in the North of Ireland of air-dried Flax straw, with bolls, at two tons, which, by the seeding machine, are usually reduced to 3,360 lb. By the various processes of the rural manufacturer, the amount of dressed Flax or fibre obtained averages from four to five cwt. per acre."

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	₹	a.	p.
Boat-hire, at 8 annas per ton	50	0	0
Chaunder (person in charge of boat)	7	0	0
Carriage of the plant, at ₹1 per bigha	100	0	0
Four Zilledars, for six months, to look over the cultivation, at ₹3 each per month	72	0	0
	2,156	12	0
Exchange, at ₹3-12 per cent.	80	14	0
Co.'s ₹	2,237	10	0

"*Monghyr Experiments.*

"'The culture of Flax was commenced near Monghyr, on the Ganges River, in the year 1839; and specimens were presented to the Agri.-Horticultural Society, in May 1840, and again in the month of September in the same year.

"'The strength of this Flax, as ascertained by Professor O'Shaughnessy of the Medical College, Calcutta, was as follows, and as compared with other kinds tried at the same time:—

Monghyr, undressed	40,000
Archangel	43,000
Baltic, dressed	42,033
Do. undressed	19,075
Irish, dressed	17,075

"Mr. Deneef considered it the best sample of India-grown Flax that he had seen.

"The sentiments of some of the members of the Flax Committee were as follow:—

"*Mr. Hodgkinson.*—'The samples of Flax are of middling quality; the fibre fine and strong, but deficient in cleanness and colour. The first defect arises from carelessness in scutching.'

"*Mr. Willis.*—'The Baltic *rough Flax*, which of all the specimens it is the most legitimate for us to compare with the Monghyr *undressed one*, is superior to it in colour, lustre, mellowness, and cleanliness.' The *Monghyr undressed Flax*, not having undergone the degree of cleansing, and preparative manipulation which has been given to the *Baltic rough Flax*, being more ligneous, &c., is not exhibited with all the comparative advantage it otherwise would have shown. The Monghyr *undressed* specimen seems to possess more *tow* in proportion than the rough Baltic one. Its strength of fibre seems somewhat inferior to that of the Baltic one. Its length of fibre seems good. But after all it seems so promising a production that I think the parties engaged in the experiment would do best to send home a good supply of it to the various markets of London, Liverpool, and Scotland, that they may derive the opinion of merchants, brokers, and manufacturers as their most true and unerring guide.

"Mr. Wallace again submitted, in August 1841, two samples of Monghyr-grown Flax, to show the improvement on last year's produce. He stated that they were average samples of thirty-four bales (nearly four tons) which had just been shipped by the *Mary Bannatyne*, for London.

"'*No. 1.*—Grown from country seed on a strong black soil, which had been inundated by the river, and retained its moisture through the season. The seed was sown on or about 10th November 1840. Twenty seers of clean seed to a bigha (the bigha is rather larger than that of Bengal); the plant was allowed to ripen fully, and the seed to come to full maturity. This was all saved by rippling combs, which separate it easily from the stalk. The soil received very little preparation; it was drilled with one plough, another plough following in the same track in which the seed was sown. The plant was pulled about the 20th March, and steeped for three days. The breaking or crushing of the plant was done by machinery; the scutching by hand. A man could clean of this quality of plant five seers a day. The outturn per bigha was 9 stone, such as the muster, and 3½ maunds of seed.

"'*No. 2.*—Grown from country seed on a light sandy soil, also inundated by the river; was sown about 8th October, with the same sort of seed; the land was well prepared, having had three or four ploughings; the seed was sown broadcast 25 seers per bigha; it was allowed to ripen fully; it was pulled 28th February, and steeped 4½ days. The outturn of this was about 1½ stone per bigha, and one maund of seed—no rain having fallen from the time of sowing, seven-eighths of the crop was lost; the dressing of this was similar to the other. A man could not scutch more than 2½ to 3 seers per day.'

Cultivating Flax. (*G. Watt.*) LINUM usitatissimum.

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"Mr. Wallace, in his reply to the queries of the Society, states that the bigha at Monghyr contains 3,600 square yards—three-fourths of an acre, and that the inundated land is to be preferred. Alluvial land will yield a crop if not too sandy, but the higher land is preferable if rain fall two months after sowing; that dry soil produces a good plant, but of very coarse quality. He sows at the latter end of September for *seed* only, but from 15th October and all November for fibre, to the extent of 60lb to the bigha if sown broadcast, and 40lb if sown in drills.

"The American and Europe seed, he states, produce double the quantity of fibre, half the quantity of tow, and of a finer quality, but only half as much seed as the native. Of this the price in the district was from R1-4 to R1-8. That he reaps from the 25th of February to the 10th of May. That the average crop is about 9 stone, or 126lb per bigha; and that sixteen of these are required to produce a ton of Flax; with of tow, first quality 36lb, and second quality 14 lb per bigha; while there is an average crop of 3½ maunds of seed. The time of steeping varies from two to three days in the hot months. to four and five days in February, October, and November, and to seven and eight days, in the cold months of December and January; and that one day more is to be added for dry plants of the preceding season; and that the cost of Flax laid down in Calcutta, per ton of 20 cwt., is from £12 to £15, all expenses included.

"These expenses consist of rent of land, R1-8 to R2 per bigha; if the rayat uses his land in the other months, then four annas less than the above rates. Coolies obtainable at 1½ annas per day for rippling, steeping, or carrying to the factory; or one rupee for fourteen bundles of 3½ cubits in girth, tightly compressed. It is steeped in a vat, and taken out when the fibre will separate easily from the wood, and then dried in the sun. It is crushed by being passed under large iron rollers, and then placed on the edge of a board, where the fibre is separated from the wood by striking it with a wooden sword. The expense is R3 per bazár maund, and the conveyance to Calcutta, R20 per 100 maunds. Notwithstanding the small cost (£12 to £15) for a ton of Flax laid down at Calcutta, which was pronounced of good quality, and probably similar to the other Indian Flaxes, which were valued in England at various prices, varying from £35 to £45; also stating that the amount realised on the sale of the seed is calculated to have more than covered the expenses of cultivation, rippling, and steeping (*Report in Agric. Soc. Proc., Nov., 1841, pp, 38 and 95*): the speculation did not succeed. For we find in the *Proceedings* of the same Society for February, 1844, pp. 45 and 165, Mr. Wallace, intimating, in reference to his operations for several years past with a view to establish the cultivation of Flax at Monghyr, that he was afraid, from the serious drawbacks he had experienced, that he should be compelled to abandon the speculation unless some encouragement was afforded by Government. The Society having referred all the papers and samples of Flax received from Mr. Wallace to their Hemp and Flax Committee for report, it is stated that one of the members was in favour of an appeal to Government, while the other three were opposed to such a step; but as neither the facts nor reasons for either side are given, we are unable to draw any other general conclusions.'

"The foregoing rather detailed account of the experiments, culture, preparation, and cost of Flax grown in different parts of India, may appear to the reader to have occupied more attention than their importance entitles them to. But without going through this labour, it would be impossible to draw any satisfactory conclusions for the prosecution of any future experiments in the same or in other parts of the country, if such should be thought necessary. But it is first desirable to know what was thought of these fibres when sent to the markets of this country. This we are fortunately able to do, from some of the results having been published, and from some of the specimens having been sent to the India House. A detailed report is given from Liverpool of the first samples grown, and of which a report had also been made by Mr. Deneef. But he generally rated them higher than they were valued in this country, though we are unable to distinguish exactly the respective specimens in the two reports. The Secretary next submitted an extract of a letter which he had been favoured with by Mr. Hodgkinson on some samples of Flax (similar to those so favourably reported on by the Flax Committee of the Society) forwarded by him to Liverpool. (*Vide* 'Report' 1841, p. 41.)

"'The letter, which bears date January 30, 1841, is from Mr. Grey, and he says: 'From what I can judge, and having shown them to a friend here who has probably as much through his hands as any other in Liverpool, a partner of William Jackson, Son, & Co. Mr. Murray seemed far from sanguine about them, but I trust they indicate the capability of producing an article of great importance and extent.

"'*1st.*—The best is a lot (country Flax, native seed, 26th May 1840)—this may be worth £40 to £45 per ton here; it is finer, softer, and better than—

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"'*2nd.*—The large parcel (country Flax, native seed, 27th May 1840)—which has a fine broad fibre, and not much inferior; it is worth £40, if in quantity equal to sample. The lengths are too unequal, which makes it fall upon the hackle, and is a disadvantage. Of these two samples the fibre is by no means weaker than of many other such Flaxes, and probably when this is the case it arises from the preparation.

"'*3rd.*—(Bengal, May, prepared by Belgians.) Dew-ripening weakens, I understand, the fibre, hurts the colour, and even prevents its bleaching as it ought to do, and for which such Flax would be used. Where water is obtainable for steeping this method should not be resorted to.

"'*4th.*—(Indian Flax, No. 1, grown in the neighbourhood of Calcutta, worth at least £30 per ton.) This is better, but seems, if I mistake not, also to be dew-ripened. It is worth £35 here, however.

"'*5th.*—These from imported seed don't seem equal to the produce of native.

"*6th.*—The heckled Bengal Flax does not show to advantage, being imperfectly dressed, and happens to be of a dry, hard nature.

"'*7th.*—(Country Flax, native seed, 26th May, 1840.) This mark is similar to the first, but you will distinguish it, being darker coloured and harsher. The first is the best, I think, decidedly. Weakness of fibre is an insuperable fault where it exists, and it may be perhaps avoided by better preparation. The Belgians' is very weak, and some of the others.

"'*Tows.*—One of these (Bengal Tow, native seed, 30th May 1840), seemingly the clearing or last tow, is a very good thing, worth in Dundee £30 to £33, I should say; the others from firmer tools before this, £20. Another of same mark as first worth perhaps £16. These are of great consumption, as recommended before to your attention Codillas from £12 @ 16 20 per ton would do well, and could be obtained from the waste in preparing the better Flax, observing always that the staple be good and the fibres strong, though they need not be of great length by any means. In Flax the longer the better, though not required beyond moderation, but the fibres should be *equal* and uniform, so as all to split and yield as much dressed as possible. These Flaxes on the whole resemble most the common Newry Flax, which costs £40 @ 50 per ton, wanting the natural sap, in which all these are deficient.

"'The quality I think will not be of the best for some time, but much that would sell largely in Dundee or even Belfast might be obtained; in Dundee everything is used, down to the coarsest; but Flax worth £40 to £60 per ton is most saleable, and to the most certain and best buyers. The Codillas and Tows there seems no doubt of, and Flax to bring from £30 to £45 per ton also.'

"The next report we have is on the samples of Flax grown in the following year (1840):—

"'Four specimens of country-grown Flax, prepared in Calcutta.—*Presented by Mr. H. Woollaston on behalf of the 'London Flax Experimental Society.'*

"'No. 1—Is a sample of Flax of last year's growth, from English seed, *not acclimated*. Six hundred pounds of this quality, Mr Woollaston mentions, were forwarded to London by the *Bucephalus*; and by the last mail Mr. Rogers advises that it was valued at £50 per ton.

"'No. 2—Is a sample from *acclimated* English seed, grown in Entally. The seed was sown last November, and the plant gathered in February, having been in the ground 85 or 90 days. Mr. Woollaston states that this sample is considered much *superior* to No. 1, and that Mr. Deneef attributes its superiority to the seed being acclimated, which renders the separation of the under-bark much easier, and leaves the Flax finer and softer. Mr. Deneef estimates its value compared with No. 1 at £56 per ton.

"'No. 3—Is a sample from the same seed and growth as No. 2—but consists of *picked* portions of plant, so as to furnish a specimen of the degree of fineness that it is possible to produce. This sample is superior even to No. 2, and nearly equal to the best produced in Belgium; much surpassing the £60 Belgian ordinary qualities. Mr. Deneef estimates its value at £60 the ton.

"'No. 4—Is a sample of Flax from *country* seed grown and prepared at Bowsing Factory, district of Burdwan; estimated in London at £40 to £45 the ton.'

"Some specimens of the Flax grown this year having been sent to the India House, and having, in March 1841, been examined by Mr. Hutchinson, of Mark Lane, he thought them very favourable specimens of so recent an experiment, as they seemed to be equivalent to Russian and Polish Flax, which was selling at that time for £40 a ton; and one of the specimens appeared of a quality which might sell for £45 a ton in the then state of the market.

"Mr. Enderby, then of the rope-manufactory at Greenwich, thought yarn made of it very good, and that nothing could prevent both the Flax and Yarn proving valuable

articles of commerce, it sent in quantities, and of uniform and sorted qualities. Messrs. Noble have recently informed the Author that they also had received specimens, and thought them equal to the middling and even better qualities of Russian Flax. There seems no doubt, from the concurrence of opinion, that the Flax produced in India was sufficiently good to stand favourable comparison with both Russian and Egyptian Flax, and was, therefore, of the kind which is much required, and which could be consumed here in the largest quantities. The question, therefore, is whether it can be produced at a cost so as to yield a profit to both planters and the merchants who would export from India to England.

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"OBSERVATIONS ON EXPERIMENTS.

"On reviewing the accounts and the results of these experiments, it appears that though abandoned too soon in some situations, they were carried on for a sufficiently long period in others to allow of reliable deductions being drawn from them, if full information on all points had been supplied. The soil does not seem to have been complained of; but though drainage is essential in many parts of Europe, the power of irrigating will be found most useful in the East. The climate is obviously very different from what the plant meets with in Ireland, as not a drop of rain seems to fall from the time of sowing to that of reaping the crop; but heavy dews compensate for this deficiency during a part of the season. But as this dryness of climate prevails over a great part of India during the season of cultivation—that is, from the end of the rainy season to the beginning of the hot weather—it is evident that irrigation is necessary for such cultivation, and must not be too expensive. Perhaps the double monsoon of the Madras Presidency might in some localities afford a suitable climate if the temperature is not too high. A perfectly appropriate climate may no doubt be obtained at different elevations on the Himálayas, and in some of the mountainous ranges of the South of India; but European superintendence may not be available and the expenses of transit be too great. The Saugor and Nerbuddah territories appear favourable, from their more moderate climate; while some of the districts of the North-West of Sindh, and the Panjáb, may be found suitable, from the command of irrigation and the prevalence of a moderate temperature.

"The proportion of seed required having been ascertained by Mr. Deneef, we cannot but observe the unexpected results obtained from the sowing of some native seed—the Flax produced from Saharunpore seed having been considered to be of excellent quality, and, in Liverpool, to be the best of all the specimens sent. American seed was found to be suitable to the country; but it is remarked that when sown in a rich, it did not do so well as when sown in a poorer, soil. The whole question of what is the best seed for the untried soils and climates of new countries is one of considerable difficulty. It does not follow that seed from a rich soil and the most careful cultivation is necessarily the best for transference to a poorer soil and drier climate; indeed, the converse would, in many cases, appear to be the more suitable course. But even in the case of wheats, some from Australia and from the Nerbuddah, pronounced the finest in the English market, have never produced good crops in this country, notwithstanding the most careful attention. Indeed, the most advisable course appears to be to grow the best native seed, and as thickly sown as is found to be suitable, for the express purpose of changing the branching nature of the plant, and then making an exchange with the seed of other districts following the same course; in order to insure that interchange of seeds which is so beneficial for all kinds of crops, and is conspicuous in India in the indigo crops of Bengal being grown from the seeds of the North-West. In the directions for culture in Europe, we have seen that early sowing is necessary to produce good fibre, and late sowing for seed; but in India the reverse course is to be followed, for early sowing, in consequence of the high temperature, induces rapid but, from the dryness of the climate, stunted growth with an abundant production of seed; while later in the autumn the temperature is lower, the growth is slower, but the dews being heavy there is greater moisture, and this, with the slower growth, produces finer fibre. The early sowing is preferred by some, in order to save the expense of irrigation, but this must sometimes be with the sacrifice of the quality of fibre.

"With respect to the cost at which Flax can be produced in India, we find Mr. Leyburn stating that he gets four maunds of Flax, or 328lb, from about one-third of an acre of land, at a cost of £2-10*s*., or for about £17 a ton; and that this sold for £28 a ton in London; but we do not find that he proceeded with the cultivation. Mr. Deneef calculated the cost of Flax produced by him to be £32 a ton, with a profit of £8, which would afterwards amount to £14. Mr. de Verinne calculated the cost would be £31 a ton, with an average crop; though he did not get half the quantity. The cost of both is evidently too high, unless the finer qualities of Flax are produced. Mr. Wallace, who continued the longest, and produced Flax at the

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cheapest rate—that is, from £12 to £15—ought to have succeeded, as he states that the expenses of cultivation were paid for by the seed. But we find him, as we have already stated, representing to the Agricultural Society that he should be unable to go on with the culture, from the discouragements he had met with, unless assisted by the Government. Though the difficulties are not specified, they must have been greater than appear from the published accounts, and therefore the facilities and the profit are not so great as they appeared to the *Agri.-Horticultural Society*,—who thus unintentionally induced the Government of Lord Auckland to consider that public aid was not necessary.

"It is very evident that such experiments can only be made under the superintendence of Europeans, when, if successful, they may be adopted by natives. In repeating the experiments in more favourable situations, it would seem very desirable at first to ascertain as accurately as possible the quantity of produce of ordinary quality obtainable per acre, with good cultivation in a favourable locality, on an average of years, and then to endeavour to improve the quality. The profits of the two kinds of cultivation and preparation are not very dissimilar in Europe. Though manufacturers may require more of the coarser qualities of Flax, planters will of course grow that for which they can get the best prices; though it will be safest at first to reckon only on getting the prices of Russian or Egyptian Flax."

As bringing Royle's account down to more recent times, the following special report, written by Mr. W. H. D'Oyly, Collector of Howrah (which appeared in the Proceedings of the Revenue and Agricultural Department for 1873), may be given. The report is of so great interest that it is feared it would be seriously injured by any attempt at abbreviation, though in some instances Mr. D'Oyly deals with some of the facts given above in the passage from Royle's *Fibrous Plants of India*—his report is, in fact, a review of Royle's statements and of all that had subsequently appeared. Mr. D'Oyly, in forwarding his report, accompanied it with a letter from which the following passages may be extracted, as showing the extensive research made by him which resulted in his report embracing chief facts continued in the Agri.-Horticultural Society's Journals as well as his own original enquiries:—

"While I was at home, or rather on my way there and back, I picked up all the information I could get from the journals of the Agri-Horticultural Society of India and several other books regarding the cultivation of flax in India; the enclosed report is the result.

"Dr. Forbes Watson very kindly took a great deal of trouble in hunting up all the records of experimental cultivation and manufacture in India, and supplied me with numerous extracts from the records of the India Office. I now send on the report to you, as it may be of some use to Government. It has been proved that there is nothing in the soil and climate of certain parts of India against the production of good fibre; in fact, very good fibre *has* been produced, but it has not yet been proved whether the cultivation and manufacture can be carried on *profitably*. Panjáb flax manufactured by Government was proved by sale at auction to be equal to Russian flax; which is better again than Egyptian. Now, if the Egyptians can make it pay, we ought to be able to make it pay also. If India could be made a flax-producing country it would be a grand thing not only for India, but for England.

"I believe I have cited chapter and verse for every statement I have made, so that there may be no mistakes.

"*Report on the cultivation of Flax in India.*

"OBJECT.—The object of this paper is to show, in as concise a form as possible, the results of the several experiments that have been made from time, to time both by Government and by private individuals, in the cultivation of the flax plant for fibre in various parts of India, and to urge the prosecution of further experiments in such a manner as to give them at least some chance of success. By success I mean something more than the success which has already attended many of the experiments which have been made; for, although it has been proved that fibre can be produced from the flax plant grown in this country when the cultivation is properly attended to, and that such fibre would find a ready sale in some of the home markets, still India has not become a flax-producing country.

"NATIONAL IMPORTANCE OF INDIA AS A FLAX-PRODUCING COUNTRY.—That England should be able to supply her manufactories with flax from India, instead of depending so much as she does on Russia, Prussia, Egypt, and other countries, is a matter of incalculable importance. I exclude Belgium, as there is at present no sea-

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son to anticipate any difficulties with regard to the supply from that country, and also because India, though perhaps she may not hope to equal Belgium in the *quality* of her flax, might still well compete with Egypt, Russia, and other countries. For the Dundee market the Indian flax that has already been produced in the Panjáb is admirably adapted. In the Dundee Chamber of Commerce, Mr. O. G. Miller, the Chairman, in 1858, speaking of the Panjáb flax, specimens of which were laid on the table, said that 'the fair value of the flax at the present time he considered to be fully £45 a ton overhead, and he would be glad to take a quantity of it at that price.' 'Indeed, a mixture of this flax with that of the Baltic *would much improve the yarn by imparting strength to it.* Such flax would be therefore admirably adapted for canvas yarn and other yarn where great strength was required. Every one then would agree that if a supply of *some thousand tons annually* of this flax could be obtained at a fair price, a very great boon would be conferred upon the linen manufactures of this country, and this district in particular would be benefited more than Belfast or any other town, for we have a hold of the coarser end of the linen trade, for which this flax is better adapted than for the finer spinning of Belfast and Leeds.' Dr. Royle, in his work on the *Fibrous Plants of India (page 141)*, quotes from a letter written by Mr. J. McAdam as follows: 'Belgium, Holland, France, and Ireland can supply all the world with fine fibre, but Russia and Egypt cannot keep pace with the demand for coarse.'

"FAVOURABLENESS OF THE PRESENT TIME.—I believe that the time has now come when the cultivation and manufacture of flax can be carried on in India profitably—certainly with more hope of profit than it was reasonable to expect in former years—*first*, because higher prices can now be obtained in the home markets; *secondly*, because the means of communication both in India and also between India and England have been so much improved, and the rates of freight have lately been so much reduced;* and *thirdly*, because the great irrigation works lately undertaken by the Government of India in Behar and in other parts of the country, and which are being extended throughout immense tracts of dry and thirsty, and therefore hitherto comparatively unfruitful, lands, will supply the only thing wanting to enable farmers to turn these lands to good account,—lands now in many places lying waste to a great extent, and even where cultivated, obtainable in many parts at a very low rate of rent.

"THE FLAX PLANT OF INDIA.—The Indian plant called *ulsee* or *teesee* is a variety of the flax plant which is grown exclusively for the seed from which linseed oil is expressed. This variety has acquired certain characters from the peculiar method of culture adopted with a view to obtain as great a quantity of seed as possible; and this is done at the expense of the fibre, for the plant, in consequence of the peculiar method of culture, is always *short* and *bushy*. The same thing occurs with the plant known commonly in India as *ganja* or *bhang*, which produces an intoxicating drug; this is the true hemp plant (**Cannabis sativa**), and in India it is not cultivated for fibre, but for the 'resinous secretion of its leaves.' Dr. Royle in his work on the productive resources of India, says: 'In Europe it is well known that if it be wished to prevent a plant secreting the principles, bitter, acrid, or otherwise, which are natural to it, the practice is to exclude it from the influence of light and air, as in tying up lettuces and covering up celery; so to ensure a full secretion of the principles natural to a plant, an opposite treatment is necessary, and is practised with the hemp in India by openness of planting and consequent exposure to the full influence of light, heat, and air.' Hence the flax plant in India being valued on account of the oil of its seed, is sown in lines on the borders of fields, and not thickly, so that it becomes short and bushy, with many branches yielding a heavy crop of seed. This every one who has seen anything of the country where linseed is cultivated must have observed. To secure length and fineness of fibre, it is necessary to sow both hemp and flax very thickly in the same way that jute and sunn-hemp are sown.

"EARLY EXPERIMENTS.—It appears that the attention of Government was first directed to the cultivation of fibrous plants in the beginning of the present century.

* In the first part of the year 1855 the freights for jute varied from £5-5*s.* per ton to £6-5*s.* The quotations now (end of April 1873) are £2-12*s.* per ton. In July 1872 the steamer *City of Cambridge* took home 100 tons jute at £3 per ton, and in the same month the *City of Canton* took 300 tons jute at £2-10*s.* per ton. The *City of Lucknow* took 500 tons jute at £2-7*s.* 6*d.* per ton. In May 1872 the ship *Tythonus* took 625 tons jute at £2-5*s.* per ton. In both the years 1872 and 1873 the highest rates for jute did not exceed £4 per ton.

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The East India Company had hemp farms, and Dr. Roxburgh seems to have been the first to attempt the production of flax in India. Unfortunately no record appears to have been preserved of the result of his experiments. Dr. Royle who published a work on the fibrous resources of India, called attention to the subject in 1834, but little seems to have been done till 1839, when a company was formed in London called 'the London Experimental Flax Company.' By them a Belgian farmer and a Belgian preparer of flax were sent out to Bengal, and experiments were made with more or less success in several parts of Bengal, Behar, and the North-Western Provinces. Riga, Dutch, and country seed, were all tried. Generally, as might be expected, the Riga and Dutch seed proved better than the country seed, still some of the specimens of flax produced from the latter were most favourably reported on and considered by Mr. Deneef, the Belgian farmer, to be worth £66 a ton. This is probably a rather high estimate, for some specimens sent to Liverpool at the same time were valued at from £30 to £45 per ton; but it is right to add that some time after some Panjáb flax was actually sold at auction at £54-10*s.* per ton.* The Agricultural and Horticultural Society of India took the matter up warmly. Medals and prizes were offered; but although the results of experiments were encouraging, the cultivation did not till many years after extend beyond the few bighas in the several places where experiments were made.

"EXPERIMENTS IN SHAHABAD.—In the district of Shahabad, at a factory called Nonore, which is on the banks of the river Soane, Mr. Lyburn for several years (1840 and previously) persevered, and although his efforts were crowned with great success, still he wrote in a desponding way of the almost insurmountable difficulty he encountered in getting the natives to take to anything new. He must here have referred to the manufacture of the fibre, and not to the cultivation of the plant, for it is beyond doubt that the natives will always take to any cultivation that will pay well, and even to the preparation of the produce, when it is not attended with any great difficulty requiring more than ordinary care. Take, for instance, opium and jute, the cultivation of which has increased so enormously. But the preparation of the flax fibre is infinitely more difficult than that of jute or sunn-hemp, and requires European superintendence, without which the natives would never produce a marketable fibre. Even in the comparatively easy preparation of jute and sunn-hemp, a large proportion of the fibre is more or less damaged by carelessness in preparation. Mr. W. Stalkartt of Ghoosery, who owns an extensive rope manufactory, informs me that no less than one quarter of the sunn-fibre brought to him is damaged by carelessness in steeping; the stems are often left for too great a length of time in the water. I may add an extract from a report by Mr. Sturrock, Secretary, Chamber of Commerce, Dundee, dated 11th March 1860 (*Journal of the Agricultural and Horticultural Society of India, Part III., Vol. XII.*):—'As to the quality, it is not nearly so good as a lot sent home by Mr. McLeod, which I sold at £54-10*s.* per ton. It is not so good coloured, is altogether harsher, and has much less of the natural sap in it. This we consider must arise from the stock having been allowed to grow too long a time, or not having been pulled early enough, *and from over-steeping, or otherwise bad preparation.*

"Again, in the *Agricultural and Horticultural Society's Journal for 1863, Part III, Vol. XIII.*, it will be seen that both Mr. McGavin and Mr. Stalkartt, in reporting on the weakness of samples sent to them for report, attribute the weakness to want of care in preparation. To return to Mr. Leyburn's experiments. It appears from the *Proceedings of the Agricultural and Horticultural Society in November 1841* that 'Mr. Leyburn succeeded in producing an article of lengthened staple, and of a quality vieing with the flax of Russia and elsewhere. A portion of the cultivation was carried on in the sandy bed of the Soane river, and part in the uplands of the district." [Mr. Leyburn's results will be seen at page 15 above.—*Ed.*]

"In a foot-note the size of the bigha is not very clearly shown. The Shahabad bigha at present contains 27,225 square feet, and is therefore about two-thirds of an acre; but Mr. Leyburn puts down his bigha as 'something more than the Bengal bigha, which is 1,600 square yards, the third of an English acre.' Still, as he calculates the produce at four maunds of flax per bigha, which is equal to one ton from seven bighas, it would seem that the bigha referred to by him must be at least as large as the present Shahabad bigha. The factory maund is equal to $74\frac{11}{16}$lb, therefore four maunds would be equal to 2 cwt. 2 qrs. $18\frac{12}{16}$lb. At my request a search was made among the records of the Nonore factory by the present owner, Mr. Solano, for any papers that there might be relating to Mr. Leyburn's experiments, but unfortu-

* This, however, was a very small quantity, *viz.*, about two tons, which was the best that had been then prepared. See extract from Mr. Sturrock's report quoted in the next paragraph.

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nately the factory was burnt in the mutiny, and no papers on the subject have been found.

"MR. DENEEF'S ESTIMATE OF THE COST OF CULTIVATION AND PREPARATION.—Mr. Deneef, the Belgian farmer above alluded to, drew out an estimate of the cost of a ton of flax produced from English seed well dressed, and in his opinion worth £50 or more in the home market. It must be remembered that this showed the cost of cultivation, &c., near Calcutta, where it was, and always will be, higher than it is up-country. It will be seen that he calculates that thirty Bengal bighas* would be necessary to produce one ton of flax."

[Mr. Deneef's estimates will be found on page 18.—*Ed.*]

"EXPERIMENTS AT MONGHYR.—Mr. Wallace, at Monghyr, for years made experiments, and he perhaps may be said to have been the most successful producer as far as cost of production is concerned. He states in a letter, dated 21st August 1841, to Dr. Spry, Secretary to the Agricultural and Horticultural Society of India, that the expenses of *cultivation, rippling, and steeping, were more than covered by the proceeds of sale of seed.* The cost of preparation of three tons he gives as follows:—

	R
Scutching of three tons after being broken or crushed by the rollers	190
Gram and grass for horses and bullocks, syces' wages, &c.	94
Peons and carpenter	10
Mofussil expenses and carriage to Calcutta	60
Boat hire and travelling expenses	10
TOTAL	364

R364=£36, or £12 per ton.

"Mr. Wallace estimates the produce per bigha† as follows:—Flax, 'average crop 9 stone, 16 bighas for a ton; tow, 1st quality 36lb, and 2nd quality 14lb; seed, average crop 3½ maunds.' He considers that the most preferable land is that which is yearly inundated; chur lands, he says, will yield a good crop if not too sandy, but high lands are preferable if rain falls two months after sowing.‡

"EXPERIMENTS AT BULLEAH, IN GHAZEEPORE.—Mr. Deverinne's experiments at Bulleah, 1840-41, were the least satisfactory of all, but a reason is given for this, and it would appear that better results were obtained in other years from his estimate of average crops. In his letter to Messrs. Hamilton and Company, Calcutta, dated 20th September 1841, he estimates the cost of cultivation of 100 bighas, and of the preparation and despatch of the produce to Calcutta, at R2,237; the yield, he estimates, in an average season, at from 150lb to 200lb per bigha, or (say) 6¾ tons per 100 bighas; the cost of one ton, therefore, landed in Calcutta, would be R331. The bigha referred to is the Duncanee bigha of 28,336 feet square, about double the size of the Bengal standard bigha. Mr. Deverinne adds that the proportion of flax to codilla is one-third flax to two thirds codilla, so that besides the 6¾ tons clean flax, there would be 13½ tons codilla? The figures given above are taken from Mr. Deverinne's estimate of an average season; but his actual return in 1840-41 fell far short of these figures. This, however, is not to be wondered at when we see that the season 1840-41 was an unfavourable one. The plant was blighted in January; from the 10th September till the 20th January, when the flax was in seed, there was no rain; country seed was used; the sowings were too late, and, by the advice of Mr. Bernard, 20 seers of seed only were sown in each bigha, which was found to be much too small a quantity for the production of good flax; part was sown with drill ploughs and part broadcast; the flax was cleaned at an improper time, *viz.*, during the hot winds;‖ instead of get-

* The Bengal bigha here referred to contains 14,400 square feet (about one-third of an English acre, and about half of the Shahabad and Ghazeepore bighas). (See reports of experiments in those districts.)

† Of 3,600 square yards, ¾ths of an acre.

‡ Letter from Mr. J. Wallace to Dr. Spry, dated 2nd September 1841. Proceedings of Agricultural and Horticultural Society, November 1841.

§ I cannot help thinking that this must be a mistake for ⅔ flax to ⅓ codilla. Mr. Deneef puts down 1 ton flax to 9 maunds (or say 7 cwt.) codilla; and Mr. Wallace estimates 9 stone (126lb) flax to 36lb 1st quality tow, and 14lb 2nd quality tow.

‖ See *Balfour's Cyclopædia of India*, page 840; also letter from Mr. Deverinne to Messrs. Hamilton and Company, Calcutta, dated 20th September 1841, published in Agricultural and Horticultural Society's Journal for 1841, page 101.

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ting a yield of 3 to 3½ maunds of seed per bigha, he harvested only 1 maund 25 seers per bigha.

"WITHDRAWAL OF GOVERNMENT AID.—Although Lord Auckland took a very great interest in the cultivation of flax, as indeed he did in all matters connected with the development of trade in the various fibrous productions of India, and though he requested the Agricultural and Horticultural Society 'to supply such accurate detailed information as they may possess, or as they may be able to obtain,' still nothing further was done by Government; for it appears that on receipt of the Society's report, the Secretary of the Government of India wrote a letter* to the Secretary of the Agricultural and Horticultural Society, from which the following passage is taken:—'The cultivation of flax can no longer be considered a doubtful experiment, since it appears from your report to have proved in many instances successful, and, where successful, to be very fairly profitable. His Lordship in Council is therefore much inclined to doubt whether any bounty or reward from Government is necessary or would be justifiable for the support of this undertaking.' This was a rather unexpected blow; the Society seems to have almost dropped the question, and the flax company seems to have collapsed.

"GOVERNMENT EXPERIMENTS IN THE PANJAB.—Later on some very successful experiments were made by Government in the Panjáb, chiefly through the exertions of Mr. Cope. These were on a more extensive scale than those that had previously been made, and Lord Dalhousie took a personal interest in the matter. The plan proposd by Mr. Cope, and approved of by Government, was that premia should be given of R500, 350 and 200, for the successful cultivation of flax on areas to be respectively not less than 25, 20, and 15 acres; that Government should purchase the entire crop, seed, and fibre of the required length, paying at the market rate of the seed, with 25 per cent. added for the fibre; that simple instructions should be drawn out and made as widely known as possible.† These and some other resolutions were passed in 1854, and operations commenced during the autumn of the same year. On the pledge of Government to purchase the whole of the produce, large areas were sown with linseed. The cultivation increased from 3,453 acres in 1853-54 to 19,000 acres in 1854-55. These are the returns for eight districts only. The services of a German, Mr. Steiner, were secured; that part of the cultivation over which he was able to exercise immediate control yielded very satisfactory results; 110 maunds of respectable fibre were thus produced, and purchased by Messrs. Harton and Company of Calcutta.

"Unfortunately, however, the instructions given were not generally attended to. I will quote Mr. Cope's own words:—

"'But, as a general rule, it was found that the zemindars had so entirely neglected the tenor of the instructions communicated to them, that a great proportion of the plant was found, on examination, totally unsuited to the production of even a decent fibre, and *in no one instance* would the zemindar exert himself to the extent of *attempting even* the preparation of any fibre, although the difficulties in the way of doing so are by no means great.‡ This preparation of fibre is, however, an operation requiring labour, and labour is what the Panjábi cultivator dislikes of all other things if he can possibly avoid it, a fact that points to the *desirableness of introducing machinery*§ on an extensive scale, leaving the country-people to cultivate and increase the growth of whatever of a vegetable character may be applicable to the arts of Europe.'

"Again, Mr. Cope says: 'The Indian, or more correctly the Panjábi, in fact does not know what labour is. No wonder he prefers sitting smoking his *hukah*, now and then peeling his sunn stems by way of a change, to standing up like a man to break and scutch flax or any similar profitable, but distasteful, occupation. He may be brought to grow the plant, but I much fear that is all—for the present at least.' There is undoubtedly a good deal of truth in these remarks. All the flax

* From T. H. Maddock, Esq., Secretary to the Government of India, Revenue Department, dated Council Chamber, the 22nd November 1841, to H. H. Spry, Esq., Secretary to the Agricultural Society.

† See paper on the introduction of flax as a fibre-yielding plant into India, and especially into the Panjáb, by H. Cope, published in Vol. XI. of the Journal of the Agricultural and Horticultural Society of India, 1859.

‡ Here I think Mr. Cope is wrong, for the testimony of all other persons whose experience renders their opinions of great value, shows that the preparation of the flax fibre is more difficult than that of any other fibre—rhea perhaps excepted.

§ The italics are mine. In a paragraph below I have given my reasons for the belief that the use of machinery is necessary for preparation of this fibre in India.

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that was produced in the Panjáb was produced by hired labour, except in one isolated instance, namely, at Deenanuggur, where Mr. Cope found that a small quantity had been prepared by the cultivators.

"Owing to the inattention of the cultivators to the simple instructions given, the premia offered by Government were not *earned*, none of the prescribed conditions having been complied with. Mr. Cope, however, recommended that the premia should not be altogether withheld, and a sum of Rı,491 was apportioned to the most deserving cultivators. Unfortunately, however, the payment *was delayed for two years*. It is therefore not to be wondered at that farmers and cultivators lost the small interest in the matter which had at first been excited by the offer of the premia. Lord (then Sir John) Lawrence, in the Panjáb report of 1855-56, says: 'In 1855 (the autumn of that year is here meant) about 25,000 acres of linseed (that is, half the superficial area sown in 1854-55) were sown, but the season, being dry, was unpropitious; no merchantable flax was obtained.' Now, irrigation would have prevented the loss caused by the dry season. Mr. Cope; in his paper above cited, says that Sir John Lawrence must have made a mistake, for 'the very fibre which has attracted so much attention at Belfast, Dundee, and Leeds, was prepared from flax grown in the districts of Gujranwalla and Lahore during the season of 1855-56.' The quantity sent home, however, was very small, being about two tons. Some 55 maunds, prepared by Mr. Steiner, were sent to Belfast, where the quality was tested. At a special meeting of the Chamber of Commerce at Belfast, the question of the cultivation of flax in India was discussed, and some yarn, spun from the Panjáb flax, was examined and pronounced to be of the value of from £35 to £45 per ton. Subsequently at Dundee a meeting of the Chamber of Commerce was held (September 1858), and three kinds of flax from the Panjáb were valued respectively at £48, £46, and £38 a ton. The Chairman, Mr. Miller, remarked on the strength of the Panjáb flax. In a letter, dated Lahore, 20th July 1859, written by Mr. T. H. Thornton, Personal Assistant to the Officiating Financial Commissioner, to the address of the Secretary to the Government of the Punjáb, the financial results of the experiment are given. In looking at these results we must remember, as Mr. Thornton says, that the object of this experiment 'was not to ascertain whether the exportation of flax could be remunerative, but to make investigations regarding the soil best adapted for its culture and to initiate the zemindars into the processes required for preparing the fibre for the European market.' 'It appears also that a considerable portion of the seed and inferior fibre was distributed gratuitously among the zemindars.' Attached to this letter is a statement of the sale proceeds of Gujranwalla flax, which I give below, as it shows what a large margin is left for the cost of cultivation and preparation :—

	£ s. d.	£ s. d.
RECEIPTS.		
Sale proceeds of 19 bales sold at Belfast, as per account	63 6 4	
Sale proceeds of 9 bales sold at Dundee, as per account	28 15 10	
		92 6 2
DISBURSEMENTS.		
From Wazírabad to Múltan, including cost of packing	4 10 1	
From Múltan to London	16 0 6	
„ London to Belfast per steamer, including warehousing in London, commission, &c., &c.	4 15 0	
From London to Belfast, including storing, commission, &c., at Belfast	3 18 2	
For carriage of 9 bales to Dundee, &c., &c.	1 12 9	
		31 8 6
Net proceeds	...	60 14 8

"Now, it will be seen from the above that after paying all costs of carriage, packing, warehousing, and commission, there remained a balance of £60-14-8 to cover the expenses of cultivation and preparation of two tons (or rather less) of flax. Then again, over and above this there would be the proceeds from the sale of seed and codilla. Mr. Wallace of Monghyr found that the proceeds from the sale of seed alone covered the cost of cultivation, and he has shown that the expenses of preparation, packing, and carriage to port need not exceed £12 a ton—say £24 for the two tons; but even if we double this amount, there still remains a large balance for profit.

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"MR. GUBBINS' EXPERIMENTS AT ALLYGHUR.—In 1854-55 and 1855-56 Mr. Gubbins, then Judge of Allyghur, made some experiments, using both foreign and native seed, and sent some of the flax straw produced to the Agricultural and Horticultural Society in Calcutta, and also some specimens of fibre, prepared in a rough way, *without the usual process of retting*. The straw was forwarded to the Chamber of Commerce, Dundee. This was grown '*from native seed and after the native fashion solely for the sake of the seed.*' (See *Journal of the Agricultural and Horticultural Society, Vol. IX., 1854, p. 379.*) Mr. Robert Sturrock, Secretary to the Chamber of Commerce, Dundee, thus reported on it: 'From this it appears that if proper means as to sowing, growing, and cleaning are taken, India may be a flax-producing country; and in order that we may be provided with as much information as possible, could you state at about what price such fibre, prepared and ready as the sample, could be shipped from India? Unless it can be laid down here at a certain cost, it could not be used; and I have to mention that the Directors of the Chamber consider that if such flax could be laid down at a price not exceeding £35 a ton, it would be useful in the manufactures of this place. The price refers to this particular sample; *if better more could be got.*' These remarks referred to the following report:—'On examination you will find it, I think, to contain considerable promise, there being evidently nothing in the soil or climate of the district in which it is grown opposed to the production of a flax that could be used by spinners generally in this country. From the straw having been intrinsically a very poor article, such as the flax steepers in this country would scarcely purchase at all, you will find the quality of the finished sample also indifferent, but nevertheless it is a *marketable article*, and I think good results might follow if another experiment was made in which more pains was bestowed on the cultivation.' It must be remembered that this flax was raised from country seed sown thinly in the same way that natives sow for the sake of a good crop of linseed. Mr. Gubbins, to show the natives what use could be made of the enormous quantity of refuse *ulsee* straw which they throw away after the seed has been collected, made from some of this refuse straw a quantity of string which was purchased by a Calcutta firm. It does not appear whether his lessons yielded much fruit; but I suppose that there being no purchasers on the spot, the experiment was dropped, and now, as formerly, thousands of tons of *teesee* stalks are thrown away, from which at least a large quantity of string could be manufactured without expense and with very little trouble. In some parts of India the stalks are given as food to cattle; but cattle are equally fond of the refuse after the fibre has been extracted. In the steam retteries in England the water which runs through the flax stems is always used with the husks of flax and chopped straw to feed cattle, and forms a very nutritious food. (*See Mr. Blechynden's notes of a visit to Wishaw Flax Works, Journal of the Agri.-Horticultural Society for 1854, Vol. IX., p. 27.*)

"OTHER EXPERIMENTS ON A SMALLER SCALE.—Experiments on a small scale were made at Burdwan, and four samples were presented to the Agricultural Society by Mr. J. Erskine in July 1844; these were raised from acclimated and up-country seed, and were pronounced to be of a fair quality, and valued at from £30 to £34 per ton. In Chittagong Mr. Sconce, then Collector of that district (1843), produced some flax from acclimated Europe seed, and also some from country seed; the latter yielded a flax that was softer and finer, but much shorter and weaker than that raised from acclimated seed. At Jubbulpore Mr. Williams produced some flax of good quality, and Dr. Royle considered that this part of India is the best adapted for the growth of flax, the climate being a medium between the extreme dryness of the North-West Provinces and the moisture of Lower Bengal—an argument that would apply equally well to the province of Behar. The Jubbulpore hemp brought into notice by Mr. Williams, is well known, and Dr. Royle judged from its length and strength, as well as by the specimens of flax grown by Mr. Williams, that 'the climate of the Saugor and Nerbudda territories is eminently suitable to the production of flax.' The linseed of these territories is a white species, and seed collected therefrom was distributed for experiments to different parts of the country. Mr. Finch of Tirhoot found that three-fourths of the crop raised from this seed 'was destroyed by caterpillars, while the common linseed, grown in the vicinity of the white, was left untouched by them.' (*See Royle's Fibrous Plants of India*, p. 144.) Mr. Henley near Calcutta was unsuccessful. In the first year he procured from Bhaugulpore some flax straw, but the plant had been grown for seed in the native fashion, and the result was that it was too bushy for the production of fibre; the next year he took a patch of land—'fine friable loam fit for anything; it had been a cauliflower bed, and was therefore deeply spade-cultivated and highly manured.' (Letter to *Dr. Royle*, quoted above, p. 12.) He had the best seed sown very thickly. The plants came up well, and attained a height of three feet, but the result

was that the fibre was small and weak, and inferior to the Jubbulpore and up-country flax.

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"CONCLUSIONS.—From the results of the several experiments that have been made, I think it may be fairly inferred—*first*, that flax of a marketable quality, and of a quality for which there is a great and increasing demand, can be produced in several parts of this country, notably in Behar, the North-Western Provinces, the Panjáb, and the Central Provinces; *secondly*, that it is quite possible to manufacture flax fibre profitably where the area of cultivation is limited, and under the immediate supervision of a qualified European; *thirdly*, that the native cultivators generally will not prepare the flax, but that they can and will grow the plant in the way that is necessary for the production of good fibre *if it is made worth their while, i.e.*, if a price be paid for the produce equal to what the cultivators make by other crops on the same land at the same season; *fourthly*, that to firmly establish the cultivation of flax for fibre, it is absolutely necessary that Government should give every encouragement and help that it is in its power to give, and that whatever may be the nature of that encouragement and help, *it should not be withdrawn too soon*, as formerly it was, both in Lord Auckland's and subsequently in Lord Dalhousie's time.

"COLLECTION OF INFORMATION AS TO VALUE OF PRODUCE.—It remains to be seen whether flax can be cultivated *extensively* in this country in such a way as to yield a fair profit, *first*, to the cultivator, and *second*, to the purchaser of the plant and preparer of the fibre. To show this, it will first of all be necessary to calculate how much the latter would have to pay the former for the plant when ready for pulling, and for this purpose I have collected certain information from persons well qualified by long experience and intimate acquaintance with the agricultural classes to give accurate information on the subject. [The answers obtained were embraced in an appendix which it is not thought desirable to republish here, but the following remarks indicate the gentlemen from whom the facts shown in the appendix were obtained.—*Ed.*] I may mention here, says Mr. D'Oyly, that Mr. Mylne is a member of the firm of Burrows, Thomson and Mylne, who hold from Government a lease of the extensive Judgdeespore estates, which formerly belonged to the notorious rebel leader Koer Singh. This estate has been transformed by them from a jungle into one of the most valuable estates in that part of the country (Zillah Shahabad), and they bear the very highest character as zemindars. Mr. Charles Fox, with his elder brother, owns several indigo factories in Shahabad, and is the able manager of the Maharajah of Doomraon's extensive estates. Moolvie Syud Abdool Hye is the manager of the Court of Wards' estates in Shahabad, and is also a zemindar holding land in Zillahs Patna and Jaunpore. I am much indebted to all these gentlemen for the trouble they have taken to obtain for me as accurate information as possible.

"ESTIMATE OF COST OF FLAX STRAW AND OF THE MANUFACTURE THEREFROM OF FIBRE.—*Teesee* is sown by the natives for the seed crop in two ways—sometimes broadcast, and sometimes in lines with or round other crops. To make the cultivation of the same plant *for fibre* profitable to the raiyat, he must be paid for the produce of his field a sum equal to what he would get for the produce of the same field when cultivated in the ordinary way. When sown round the edges of barley, wheat, or gram fields the linseed yield per bigha would be about one maund, value R3, and the value of the produce of the other crops would be about R10, the value of fodder R2, and of the oil R3, or in all R18.* The value of seed saved for the yext year's sowings may be considered as a set-off against the value of seed sown. When sown broadcast, the yield of linseed in *a good year* might be from 5 to 7 maunds, or an average yield, taking good and bad seasons into account, would be about 3½ to 4 maunds. Syud Abdool Hye puts down the average yield at a somewhat smaller figure, but when we consider that Mr. Leyburn, Mr. Wallace, and others got 3½ maunds of seed per bigha from the plant that they cultivated for fibre, and remembering that when grown in the native fashion for seed the yield would be greater, I think we may look on Messrs. Mylne and Fox's figures as the more correct. Besides, in calculating what would be a fair sum to pay the raiyat, it is better, if we err at all, to err in his favour. Putting the average yield then down at 4 maunds, the value would be R12. In either case, therefore, in an *average season* the value of the produce of a bigha† of land from November till February or March would not exceed R16. From former experiments it appears that from 15 to 16 bigha are necessary to produce one ton of flax. If, therefore, raiyats were asked to grow the

* This is perhaps the outside value of a good crop. R16 would be rather above than under the average value of produce.

† The bigha of 27,225 square feet.

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linseed plant in the way necessary to produce good fibre, and were paid at the rate of R16 per bigha for the produce, the purchaser would have to pay R250 for the produce of 16 bighas. The seed would be worth R168, calculating the yield at 3½ maunds per bigha, and the value at R3 per maund. Deducting, then, the value of the seed from the price paid to the raiyats, there would be a balance of R88 to be added to the cost of preparation, packing, and carriage to port, and if this cost does not exceed R120 (£12) per ton (this is what it cost Mr. Wallace at Monghyr), the flax could be shipped at Calcutta at £20-16*s.* per ton. The cost of freight, screwing, and insurance, should certainly never exceed £6 per ton (£4-10*s.* would be nearer the mark); so that a ton of flax might be landed in England, Scotland, or Ireland at £26-16*s.* a ton at the outside. Then, besides this ton of flax, there would be (say) 8 cwt. of codilla, which could be disposed of in Calcutta for from £3 to £3-10*s.** The ton of flax, if moderately well prepared, would fetch not less than £40, and probably more.† The expenses in England would be about £1-11*s.* per ton.‡ In the above calculation the value of the refuse, both for fodder and for manure, has not been taken into consideration. The following table will show in a more convenient form the figures above given:—

Expenditure.	*R*	*a.*	*p.*	Receipts.	*R*	*a.*	*p.*
Price of produce of 16 bighas	250	0	0	66 maunds seed, at R3 each	168	0	0
Cost of preparation, packing, and carriage	120	0	0	8 cwt. codilla (say)	32	0	0
Freight from Calcutta to England, insurance and screwing	60	0	0	1 ton flax	400	0	0
Expenses in England, warehousing, commission, &c.,	15	8	0				
Profit	154	8	0				
Total	600	0	0	Total	600	0	0

"If cost of preparation, &c., be raised to £20 per ton.—In the above calculation it will be observed that I have adopted Mr. Wallace's estimate of the cost of preparation, packing, and carriage, which is undeniably a low one, and probably would not cover the cost if machinery was employed with European supervision; but even if we raise these figures to R200 (£20) per ton, there would still be a profit of R74-8 (£7-9*s.*) per ton if the flax sold at £40 per ton, or a profit of R24-8 (£2-9*s.*) per ton if the flax realised only £35 per ton. Another R10 (£1) might safely be added to the profit, as the freight, insurance, and screwing would in all probability never exceed £5 per ton, but, on the contrary, be found generally to cost even less.

"Steam retteries.—The several processes which have to be gone through when only manual labour is employed, from the time that the plant is ready for pulling till the fibre is ready for scutching, require great care; and without constant and close supervision, such as it would be impossible to afford with any hope of ultimate profit, the natives would never turn out a marketable fibre. The pulling, stooking, stacking, rippling, water-retting, drying, &c., &c., require the greatest care and attention. By the introduction of steam retteries, fibre can be prepared immediately the plant is received from the cultivators, and within two days. An interesting account of a visit to the Wishaw Flax Works near Glasgow is given by Mr. Blechynden, and published at page 25, Part I., Volume IX. of the Journal of the Agricultural and Horticultural Society of India for 1854. In this Watt's patent process of preparing flax is explained: 'The flax straw is delivered at the works by the grower in a dry state with the seed on.' So that all that the cultivator has to do is to grow the plant, pull, stook, and deliver it at the works. One of the great advantages of the steam processes is that the seed and chaff is *all saved*, while it is generally lost, by the cold-steeping process. 'The shoves or refuse woody matters are also employed in these new works as fuel, whereby a great saving in coal is effected.' Another very great advantage that would be gained by the introduction of steam retteries into India would be that the risk of damage during the lengthy processes of preparation by hand during the hot season, when the hot winds prevail, would

* From what I have been able to ascertain, the owners of paper-mills would gladly give from R2-8 to R3 per maund for codilla.

† Turkish flax is now quoted at £40, and St. Petersburgh 12 head at £55.

‡ The total cost is less. I have added 10 shillings, as the commission on sale of flax would be double of what is put down for jute.

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be almost altogether avoided. As regards the question whether machinery would pay in India, the best proof is that it pays in England, where a much higher price has to be paid for the flax straw. Mr. Blechynden, in his report of a visit to the Redford Flax Works, states that the proprietors contract with the farmers for the supply of flax straw at £4 per ton (*page 22, Part I, Vol. IX., Agri.-Horticultural Society's Journal for 1854*). A Committee of the Royal Flax Society of Ireland, in reporting* on Mr. Watt's system, state that 1 cwt. of flax straw weighed with the seed on yields 13½lb of fibre; so a ton of flax straw would yield 270lb of fibre. The necessary amount of flax straw, therefore, to produce 270lb of fibre would cost £4, and consequently the amount of flax straw necessary to produce one ton of fibre would cost a little over £33. If, therefore, it pays the manufacturers in England to pay £33 for an amount of flax straw which will produce a ton of fibre, it ought to pay manufacturers in India to pay the rayat £25 (R250) for the produce of 16 bighas; and I think I have shown that R250 would pay a rayat *well* for the produce of 16 bighas.

"PART OF BENGAL BEST ADAPTED TO CULTIVATION OF FLAX.—The part of Bengal which would be most suitable for many reasons for the experimental cultivation of the flax plant for fibre would be that comprised in the districts of Patna and Shahabad—*first*, because all the lands of these districts will be irrigable directly the Soane irrigation works have been completed; and *secondly*, because the soil, being a rich clay, is eminently suitable; and *thirdly*, because Dehree-on-the-Soane, where there is a large Government work-shop superintended by an officer of considerable experience and ability, would be an excellent site for the establishment of a steam rettery; and *fourthly*, because the means of communication by the several canals and branch canals will render carriage both cheap and safe. As regards the soil best adapted for flax, Mr. Deneef, the Belgian farmer, was of opinion that lands subject to inundation that are annually renewed by alluvial deposit are well suited. He writes to Dr. Spry, Secretary to the Agricultural Society, as follows:—'Les terrains qui sont renouvelés annuellement par les débordements du Ganges, ou qui sont frais et riches, conviennent le mieux pour la culture du lin.'

"Mr. Wallace thus reports† on the different kinds of lands:—

Alluvial	Will yield a good crop if not too sandy
High land	Preferable, if rain falls two months after sowing.
Inundated	The most preferable of any.
Dosala (*i.e.*, two-year land)	Very good if not too low.
Loose and sandy . . .	Plant will not come to the same perfection.
Hard clay	Produces good plant, but of very coarse quality.

Mr. Deverinne was of opinion that 'the best lands are those in which there is a small mixture of sand; such lands are easily prepared, and can be well pulverised.' The large district of Shahabad is almost entirely surrounded by rivers from which spills annually inundate and renew the lands of the riparian estates. There are also in this district a great number of Government and Court of Wards' estates, so that almost every facility exists for experiments on a large scale.

"PROPRIETY OF GOVERNMENT ENGAGING IN TRADE.—There is a considerable difference of opinion as to the propriety or otherwise of Government engaging in trade. I would point out the case of Egypt. I think that there can be little doubt that it was owing entirely to Government operations that the flax trade became permanently established in that country. To this day flax is prepared by Government, and quotations in the home papers are given showing the prices of flax prepared by Government and of flax prepared by natives. The flax produced there is not quite equal to the *best* Russian, and it has been proved that flax can be produced in India which will command prices equal to those obtained for the best Russian marks. The only question, therefore, that remains to be solved is the question of cost; and I really do not see why, when the quality of Indian flax is equal to, if not better than, that of Egyptian flax, we should not be able to prepare the fibre here as cheaply as it is done in Egypt.

"FURTHER INFORMATION AS TO COST OF MACHINERY.—It was my intention, while at home on leave lately, to collect information as to the improvements in, and the

* In their 12th Annual Report.

† Letter to Dr. Spry, Secretary to the Agricultural and Horticultural Society, dated 2nd September 1841.

‡ Letter to Dr. Spry, dated 20th September 1841. These letters are all to be found in the Society's report to Government, submitted with a letter from Dr. Spry, the Secretary to the Society, dated 25th September 1841.

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cost of, machinery, the prices now paid for flax straw, the cost of preparation, and the demand for the coarser kinds of flax; but unfortunately my stay in England being of such short duration, I was unable to do so. I have, however, been making enquiries, and shall be glad hereafter to submit a supplementary report, if such information is likely to prove of any use to Government. I also propose to trace the growth of the trade in Egypt.

"CONCLUSION.—Dr. Forbes Watson very kindly supplied me with numerous extracts from the records of the India Office on the subject of flax cultivation in India. I only regret that I have not been able, from want of sufficient spare time, to enter more fully and completely into the subject than I have done. If, however, incomplete as it is, this report will in any way tend to bring the subject of flax cultivation in India into notice, and to the prosecution of further experiments, my object will have been gained. I trust that the result of such further experiments may be what is undoubtedly much to be desired, that India will some day become a flax-producing country for the benefit both of her agricultural classes and of the trade here and in the United Kingdom."

The Government of India considered Mr. D'Oyly's report of such interest that it was made the basis of an enquiry throughout India. It was accordingly printed and issued to Local Governments and Administrations, with a request for any further information which they might be able to furnish. The replies were in due course procured, and these, together with Mr. D'Oyly's report, were issued by the Government of India in 1874 in pamphlet form. Space cannot be afforded to republish all the replies, but the following jottings taken from them, together with passages derived from *Royle's Fibrous Plants* and the publications of the Agri-Horticultural Society of India, convey, it is believed, a fair conception of all that is now known of flax in the various provinces of India. The replies to the Government of India circular dealt unfortunately far more with linseed than flax, and even those that gave information regarding the fibre appear more often to be alluding to Hemp (Cannabis sativa) or San (Crotalaria juncea) than to Flax.

IN THE PANJAB.

PRESENT CULTIVATION IN THE PROVINCES OF INDIA.

I.—PANJAB.

The following passages from *Royle's Fibrous Plants of India* give part of the information regarding this province up to the date of publication of that work in 1855:—

"Though Linseed is so extensively produced throughout India, we hear nowhere of the fibre being valued and separated. But when we get to the confines of cotton-producing districts—that is, into the Panjáb—we find that some Flax, prepared by the natives on their own account, is separated in the neighbourhood of Lahore. For we are told that the stalks of the linseed plant yield a fibre, which is made into twine, and used for the network of their *charpaes* or native beds. This information was elicited in consequence of inquiries originated by Mr. Frere, the distinguished Commissioner of Sind, from his desire to promote the culture of linseed in the province under his charge. The fibre, however, of the linseed plant is separated in still more northern parts, as some seed of Bokhara Flax sown in England was found to be that of the common Flax.

"The inquiries made respecting the growth of linseed in the Panjáb elicited the following facts:—

"'On the Cis-Sutlej it is stated that three seers to a bigha are sown broadcast when alone, or in drills; probably as an edging to other crops. Three maunds of linseed considered a good crop. The stalks and husks considered refuse and useless. The seed sells for 18 seers for the rupee to oilmen. A maund of seed yields of oil 10½ seers; of oil-cake 29½ seers. The oil sells for 5 and 5½, and the oil-cake at 60 to 66 seers for the rupee.

"'In the Jalandhur Doáb, linseed is cultivated, especially in the *khadir* or inundated land of the Beás and Sutlej Rivers; but plants always small;

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seed sells for 20 to 30 seers for a rupee. It is also cultivated in the Shírwul, or tract of country in which the soil is firm and covered by a deposit from the rains, with the sub-soil always moist—ripens before barley, and generally before wheat.

"'Linseed is also cultivated in the rich loamy soils of the Kángra district skirting the Himálaya, but chiefly in the eastern parts, on account of the seed, which sells for 20 to 100 seers for the rupee—flax itself burnt.

"'In the Panjáb, sown with barley and *mussúr* (or lentils) in *Kartic* (October and November), it ripens in *Chyet* (March and April); usually sown intermixed with the above crops, or in separate patches. Never irrigated, but grown along the Sutlej, in *khadir* land, or that which is inundated during the rainy season, but never manured.

"'In the Lahore division, it is grown chiefly about Sialkote and Dínanagar, and is the only part where the fibre seems to be made use of, as it is stated that the stalks yield a fibre which is made into twine, and used chiefly for the network of their *charpaes* or native beds. The price of the seed is about R2-8 per maund. Few localities are stated to be well suited to it, and the seed was in little demand. Twine made of the fibre was sent, but no notice seems to have been taken of its quality.'

"From the above details of cultivation, it is evident that though linseed is very generally known, it is nowhere extensively cultivated, as is evident from the price of the seed, which is dear in comparison with that of wheat. Some of the uses are well known; for instance, the oil is used as a drying oil, and the bruised seed, mixed with flour, is described by **Major Edwardes** as given as a strengthening food for cattle, and the oil-cake is no doubt employed for the same purpose; while the fibre is sufficiently valued to be separated in some, though burnt in most places. It would seem much in favour of the production of good fibre that the growth is much slower than in the southern provinces of Bengal."

In 1858, **Mr. Baden Powell** informs us, a quantity of native flax from Indaura, Kángra Valley, was sent to England and was considered to be the finest specimen sent from the Panjáb, it was valued at the high price of £55 to £60 a ton, and actually sold at £54-10*s*. "If," wrote Messrs. Kani & Co. of Dundee, "flax such as Colonel Burnett sent home (*i.e.*, the specimen alluded to above) could be put on board at Karáchi for £26 a ton, it would leave to both importer and exporter a handsome profit."

Inspired, apparently, by the above results, and in consequence also of the demand for coarse flax having then exceeded the supply, manufacturers in England became very anxious to obtain flax from India. The Belfast Indian Flax Company was created in 1861, with an agency at Sialkote, which had for its object the encouragement of the growth of flax in that district, with a view to its exportation to England. The sanguine hopes of the Company were, however, shortly afterwards seriously damped by the discovery that the whole of the seed sent out by their representatives in England had been so entirely damaged on the way, that no portion of it would germinate, an announcement which produced so depressing an effect on the members of the Company that it at one time appeared doubtful if they would have the resolution to persevere in the undertaking. On the spirited representation, however, of **Dr. Forbes Watson** of the India Office, who had very opportunely received a specimen of Sialkote flax, valued at between £60 and £70 per ton, the Home Government authorised a grant to the Association of £1,000 per annum for two years, on their engaging to carry on their operations for three years at all events. Under this stimulus the Company commenced its operations with renewed vigour. The result of the first experiment was highly satisfactory. The plants attained a good height, were rich in strong fibre, and altogether very superior to the Indian plant as ordi-

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narily reared, while the fibre shipped to England was pronounced by competent authority to be equal in quality to the best Irish flax. The prospects of the movement were thus considered "most cheering." Soon, however, serious difficulties arose. The Company could not grow the plants in sufficient quantity near the factory to make it remunerative to the zamindars. When grown at a distance in small quantities, the cost and delay involved in carrying the raw material to Sialkote were out of proportion to the sale-proceeds. The apathy of the peasantry was also a great difficulty. They could not be induced to persevere in the cultivation of the plant on the approved methods it was sought to introduce, the plants produced under the European method of cultivation being not near so rich in oil as the ordinary country seed. In these circumstances, the Company had to discontinue its operations, and ceased to exist in 1867. For some time afterwards the business was carried on by Messrs. Bertola, Cox & Co., but they too relinquished it in 1869.

It would appear (from the replies received by the Government of India) that linseed is now very little grown in this province, and that the fibre, flax, is only very occasionally utilised. In Karnal 17 *bighas* 10 *biswas* of land were devoted to the produce of the fibrous plant (during the year of report), which gave a produce of 52 maunds 20 seers. The cost of preparing one *bigha* of flax was ascertained to be R3; this produced 3 maunds at a price of R2-8 a maund. The report further states that in 1855-56 flax was sown, but the results were far from satisfactory. The zamindars do not seem to appreciate the culture of the plant. In the Jagraon tahsil of Ludhiána experiments were made in 1854, but the results were not favourable. In Gujarat flax was cultivated in 1863 on account of the Indian Flax Association of Belfast, but no notes of the produce were made. In Pesháwar District flax is cultivated to a small extent and ropes manufactured from the fibre for domestic use. In Kángra it was stated that 4,432 acres were under Linum usitatissimum. In 1881-82 the area in Kángra under this plant was reported in the Gazetteer of the District to be 7,150 acres, being the largest figure for the Panjáb. The crop is grown in the valley, and is valued solely for the sake of the oil, no use being made of the fibre. Small care is bestowed upon its cultivation, the seed being simply thrown upon the ground between the stubbles of the newly-cut rice. The crop is very poor, but suffices to supply oil for local use.

The following passages in the Agri.-Horticultural Society of India allude to Panjáb Flax:—Journal (Old Series), IX., 139 (letter by Mr. H. Cope; (Proceedings, 1885, p. cxlv), Major Hollings' report on the suitability of the Panjáb for flax cultivation; X., 96 (report on samples); also Proceedings, 1858 (report on Mr. Cope's samples); XI., pp. 75-139—a detailed and important paper by Mr. H. Cope "On the introduction of flax, as a fibre-yielding plant into India, and especially into the Panjáb;" p. 188 "Report on the sale of Panjáb-grown flax in the markets of Dundee and Belfast; also (Proceedings, 1859) lvii., and (1860), VI., cv.

II.—NORTH-WEST PROVINCES.

IN THE N.-W. PROVINCES.

The Government of the North-Western Provinces forwarded, in reply to the Government of India's circular, copy of a letter from the Superintendent of the Botanical Gardens at Saharunpore, in which Dr. Jameson gives an account of the endeavours made up to 1861, in February of which year the letter was written, to extend the cultivation of flax in these provinces. Dr. Jameson relates how those trials proved fruitless, shows the causes of failure, and suggests the means which should, in his opinion, be adopted to ensure a lasting and profitable extension of the cultivation of the plant. "Before replying to your letter No. 1472A., dated 22nd October

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last, with enclosures," Dr. Jameson wrote, "I deemed it necessary to examine what had been done regarding the cultivation of flax in India, and particularly in the Panjáb, preparatory to submitting a full and detailed report. To do this I found would only be going over a subject which had been fully investigated and exhausted by the late Dr. Royle in his work styled the *Fibrous Plants of India* and by Mr. Cope in a paper lately published in the *Journal of the Agricultural and Horticultural Society of India.*

"2. In these two publications full details will be found regarding all the experiments made in flax cultivation throughout the country.

"3. In the Panjáb the subject had been taken up with energy and activity, and good results had been gained. But in my late tour I ascertained that in almost every district where the plant had been cultivated, unless that of Sialkote, it had been discontinued; the experiment, therefore, so successfully begun was too prematurely abandoned.

"4. No doubt the question that flax fibre can be raised in the Panjáb fitted for the home market has been solved, and has thus passed from speculation to fact. But still, as far as the natives of the country are concerned, nothing has yet resulted. The cultivation, instead of extending, has diminished, and, had not the Deputy Commissioner of Sialkote taken up the subject with energy and activity, the experiment would have been fruitless, or, as remarked by Mr. Cope, would have died out in the Panjáb from sheer inanition, and that, too, originating in three causes—want of perseverance on the part of the local Government; second, want of enterprise on the part of British manufacturers; and third, want of activity, energy, and interest on the part of the native cultivators in the welfare and progress of the country.

"5. In a country like India, Government, when desirous of introducing a new product, or of rendering an old one, by a process of cultivation unpractised, valuable in the arts, must take the initiative, in order to overcome the prejudices of the ignorant, indolent, and slothful cultivators. There is no active and energetic middle class to direct and encourage the labours of the native farmers, and it is a well-known fact that even in Britain there is no class more difficult to persuade to adopt new and improved processes of cultivation and new ideas regarding farming than agriculturists; and, had not the policy lately introduced opened up the country to free trade, the old and routine system of cultivating the land would have by thousands been continued to this day in Britain.

"6. The British farmer is now compelled by the free importation of grain to resort to high and scientific cultivation and the best manures, in order to enable him to hold his own.

"7. Mr. Mechi and others, through means of their private experimental farms, have shown to their tenants and tenant farmers how to maintain their position, even though the British markets be extensively supplied with untaxed bread-stuff from abroad. In this country such spirited individuals are unknown, and therefore anything to be introduced for its improvement must, I respectfully beg to state, be initiated by Government. The system at present followed by native farmers in cultivating flax for its seed is miserable in the extreme; the *shove* or straw from whence the fibre is obtained being only used as fuel, or broken up and mixed with other substances and given to cattle. Let natives be shown that substantial advantages would occur to them by cultivating the flax properly, and that good marketable fibre can be obtained from it, for which there is always a ready and immense market, and I doubt not but they would soon take to the cultivation. But, though the cultivation in the Panjáb has in most places retrograded, yet still beneficial results have ensued from the experi-

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ment instituted by Government, which may ultimately be of immense importance to the country.

"8. By the exertions of Mr. D. Macleod and others, the experiment was prominently brought to the notice of the flax manufacturers in Britain, where for years the supply of flax from home cultivation and foreign importation has been far short of the demand, and samples of the fibre laid before them, which were pronounced worth £55 per ton; and so satisfied were they, by the specimens exhibited, that the Panjáb was fitted to grow flax suited to the home market, that they formed a company, an 'Indian Flax Company, Limited, of the Panjáb,' in order to carry it on, and their agent, Mr. Wightman, has now settled in the Sialkote district, and has commenced operations. By him advances have been made to zemindars to cultivate flax, which they will repay him back in kind. He, too, has distributed acclimated seeds, and has applied to me for a large supply to extend his operations, which, however, I cannot meet. Land of his own he has none, and he is therefore entirely dependent on native cultivators. The system introduced is an admirable one, and will continue to be so as long as the company consider the interests of the native cultivator as well as their own, or, in other words, give him a fair remuneration for his labour. If this be done, and if the superintendence be confined to advice in the manner of cultivating the plant properly and preparing the fibre, and the distribution of acclimated seeds, and, above all, in a newly-acquired country like the Panjáb, where the inhabitants look to the district officers as their best advisers, if the countenance of Government through their district officers be continued, flax cultivation will rapidly spread, and the fibre become an important article of exportation.

"9. But the as yet small success gained in the Panjáb is not, in my humble opinion, sufficient to stimulate private enterprise to seek a field for operations in the North-Western Provinces.

"10. The services of Mr. Cope are not available, or if they were, they could only be procured at a rate which Government would not be prepared to meet. By him extensive mercantile transactions are carried on at Amritsar, and thus his time is fully occupied; nor is he acquainted with the methods of preparing flax.

"11. To grow the plant assistance is not required. This we can do. What are wanted are, *1st*, good scutchers and hecklers—men intimately acquainted with the processes of manufacture, and fitted to teach the natives of the country; *2nd*, the best kind of machinery used in preparing flax; *3rd*, a large supply of acclimated seeds; *4th*, the directions for the proper management of the flax crop, compiled by the Committee of the 'Royal Society for the Promotion and Improvement of the Growth of Flax in Ireland,' with a few alterations and modifications to suit the climate of the North-Western Provinces, might be translated into Hindí, printed, and distributed to native cultivators through district officers with much advantage.

"12. In the works alluded to all the information required on flax cultivation is to be found. The Agricultural and Horticultural Society of Calcutta, by publishing the most important information to be found in the reports and transactions of the 'Royal Society for the Promotion and Improvement of the Growth of Flax in Ireland,' have done all that is required to popularise the cultivation, so far as that can be done by the press, and in Dr. Royle's work on *The Fibrous Plants of India* the cultivator will find the same information condensed. To him, therefore, I would recommend this work as a text-book.

"13. Prizes have already been offered by the Panjáb Government for the best samples of prepared fibre, and for the largest quantity of land brought

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under cultivation with flax, but with no beneficial results, as they remain unclaimed by any one. Such an inducement held out appears to be of doubtful utility, though it might, with much advantage, be done on a small scale by district officers.

"14. In the magnificent system of canal irrigation, the North-West Provinces has the means for flax cultivation far superior to that possessed by the Panjáb, and to encourage it, therefore, and meet the demands for acclimated seeds on an extensive scale, I would respectfully recommend that an experimental farm of from 50 to 60 acres be formed in the Saharunpore district, adjoining the garden, where irrigated land can be procured at a reasonable rate; that the incidental expenses, such as land, rent, water, &c., be met by the sale of the seeds, a certain quantity being reserved for district officers for distribution to zemindars.

"That if European instructors from regiments be available in this country two men be obtained from the ranks of any regiment for a short time to prepare the fibre, and teach natives how to scutch and heckle. That the fibre be sold, when prepared, to meet the wages of the parties who prepare it, a large sample being reserved for exportation and examination by British manufacturers. That acclimated seeds be given to district officers, particularly those whose districts are in part irrigated by canals, to distribute to zemindars. That zemindars repay in kind with the *shove* or straw the value of the seeds received, and that small rewards, such as those distributed by the Deputy Commissioner of Sialkote, be given to such cultivators as present the best samples of flax plants for scutching. These rewards were received with the greatest satisfaction by cultivators of Sialkote, as they were distributed publicly to the recipient by their own district officers.

"15. For the plants raised by zemindars, and fitted for preparing fibre, there might at first be difficulty in procuring a market. The finest samples, however, might with advantage be purchased by Government, and from them fibre prepared for the market as an encouragement to the best cultivators. This, of course, could only be done to a limited extent. But when the field became extensive it would be high time for Government to discontinue the experiment and hand it over to private capitalists. But the seeds alone would ensure the zemindar against any loss. In fact, he would only be doing, though with better seeds, what he is now doing; flax of inferior quality and quite unfitted for preparing fibre being cultivated everywhere.

"16. In the Panjáb both Mr. hWigtman and Mr. Cope are prepared to purchase all fibre of good quality, and were it shown that flax capable of producing good fibre could be grown in the North-West Provinces, capital and funds to work it would, no doubt, be forthcoming to take it up.

"17. To do this it would be necessary to import some good seed from Courland and Livonia, and from which all the best Dutch seeds are forwarded To the acre about 2 bushels, or $1\frac{1}{2}$ maunds, are required. I would therefore recommend that a ton or 28 maunds be imported, which, with the acclimated seed which will be available this season, would enable me to cultivate 50 acres of land, an ample extent to spread the seed over the country.

"18. When the Honourable the Lieutentant-Governor visited the garden last season, he saw two fields under cultivation with flax, the one with Russian seed, the other with indigenous seed, and the plants of the former from $3\frac{1}{2}$ to $4\frac{1}{2}$ feet, and the latter only from 2 to $2\frac{1}{2}$ feet in height.

"19. From the former seed a supply was sent to Mr. Cope, then Secretary to the Agricultural and Horticultural Society of Lahore, and from it dates the commencement of the experiment of flax cultivation in the Panjáb."

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The Government of the North-Western Provinces also submitted a communication, received from the local Board of Revenue, which gave the results of the enquiries made by it as to the actual extent of the cultivation in these provinces. The substance of the papers forwarded may be here given, the broad results in regard to flax being as follows :—

"Flax (**Linum usitatissimum**) is not cultivated for fibre.

"The Commissioner of Allahabad has suggested that the richness of soil and large outlay required for the production of good flax fibre form an effectual bar to the successful cultivation of the plant for this purpose at anything like a moderate price This statement traverses the conclusions drawn in Mr. D'Oyly's report, but is supported by the fact that the cultivation of flax for fibre has been abandoned. It appears to the Board that the exhausting effect of flax on the soil should not be overlooked, and that first experiments cannot be accepted as a crucial test.

"The Board recommended that a series of careful experiments should be instituted on a small area on the Bulandshahr Farm, both on ordinary land and on highly cultivated and manured land. The experiments, if carefully conducted, would prove whether flax could be profitably cultivated for fibre, and set the question at rest as regards the North-Western Provinces.

"The report furnished by Mr. Ricketts, the Commissioner of Allahabad, alluded to above, was as follows :—A little flax is grown in a few parts of the division for local consumption, for oil and cake. It is hardly ever grown as a field crop, but only in a row drilled in, every here and there, on the edge of a field, or in furrows 10 or 12 feet apart in wheat crops. The only soil suitable for flax in this division is a porous black soil, very like cotton soil, found only near the course of the Jumna.

"Regarding the cultivation of flax, I can say that a great effort was made during the Russian war to introduce the cultivation of flax into the Panjáb : good flax was grown with a long fibre fit for export to England for manufacturing purposes, but it was established that flax to be good requires a great deal of water, good soil, and plenty of manure, and that it is a very exhausting crop. These were obstacles to the extension of the cultivation which can only be got over (as in the case of cotton a few years ago) by great demand at high prices, and a certain market, not a remote sea-port, of which the cultivators have never heard, but in the markets in their neighbourhood, to which they are accustomed to resort.

"The native cultivator has no notion of growing flax for the sake of the fibre. It is only grown for seed. The same plant cannot produce both fibre and seed. If required for fibre, it must be forced in its growth with water and manure, be planted thick, and cut before the stalk gets hard,—that is, before the seed begins to ripen. When grown for seed, the plant is sown in drills far apart, and is preferred short in the stem,—so short that the same plant could not produce fibre of a sufficient length to be of any use."

Messrs. Duthie & Fuller take, however, a more hopeful view of a possible flax culture in these provinces than perhaps do any other writers. In their *Field and Garden Crops* they say : "It is improbable that flax culture could be extended on any other system than that followed by Indigo planters, under which the grower receives a cash advance at sowing time, together with a guarantee that his crop will be purchased at a fixed price. Flax fibre would be useless to a cultivator unless he was certain of gaining a sale for it. It does not seem that any energetic attempts have been made to extend flax culture on this system, and what efforts have been made to promote it have been confined to experiments which have indeed proved the possibility of successful flax-growing, but have given native cultivators no immediate incentive to undertaking it."

in Oudh. (*G. Watt.*) LINUM usitatissimum.

III.—OUDH.

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The Chief Commissioner of Oudh submitted a copy of a memorandum drawn up by Dr. McReddie, Superintendent of the Oudh Central Jail. The practical information contained in that publication will render it valuable to those who may wish to undertake the cultivation of flax. It may therefore be quoted *in extenso* :—

"1. SOILS, AND PREPARATION OF SOIL.—The finest flax is grown on deep soils, argillaceous, sandy, and on the sandy clay commonly called loam. In strong, rich, damp soil flax will reach to a great height, but is always coarse. On light fertile soil it is shorter, but fine and silky. Deep ploughing is necessary, at least 11 inches. Fresh manure should not be used, but the manure, solid or liquid, added to previous crops made to answer. Newly broken-up pasture land does well for flax. All land must be perfectly pulverised and cleaned of all roots of every sort. Five different ploughings are necessary, with an interval of fourteen days between each, so that ploughing must begin at least two and a half months before sowing. After each ploughing all clods must be broken up, and the ground made quite even. In fact, as flax is a *rubbee* crop, the ground on which it is to be sown should be prepared in the same way as for wheat. If manure must be added, it should be done before, or at the beginning of, the rains. The manure should be spread evenly on the soil. Sheep manure should not be used.

"2. QUANTITY OF SEED PER ACRE, AND HOW SEED IS SOWN.—Flax is invariably sown broadcast; when sown for good fibre it is sown thick—230 or 240lb (3 maunds) seed per acre. When sown for inferior fibre and seed 140 or 150lb per acre will answer. It is never sown by drill.

"3. THE MONTHS FOR SOWING,—PRECAUTIONS.—From 15th or 20th October to the 20th November, according to season, *i.e.*, late continuance of rain, as flax will not stand much rain; hard rain soon after sowing would destroy the crop, hence the best time in Oudh would be the first week of November.

"For sowing, a calm day is chosen, if possible; if wind prevail, the sower must move with the wind on his side, not on his face or back. A uniform distribution of the seed would be insured by going over the ground twice and sowing half the amount of seed each time. The sowing is not to be done as for wheat, -that is, not after the plough, as it were in drills, but as stated above, broadcast by sowers walking over the field. The progress of the sowing may be marked by a seed harrow going over the field in the line of the sower. When sown, the seed is harrowed into the soil, and a light hand-roller drawn by a man is passed over it; this last operation should not be omitted. Care must be taken not to bury the seed too deep.

"To get the seed to germinate quickly, it is well to sow immediately after a shower of rain.

"4. WHAT IS TO BE DONE AFTER SOWING.—When the plants are 2 inches high, the ground must be carefully weeded. This is done by a number of men kneeling amongst the flax and carefully removing by hand all the weeds; they must work facing the wind, so that the young plants may raise themselves with greater facility. If one weeding is not sufficient, the operation must be repeated. If not feasible earlier, the weeding must not be delayed beyond the time when the flax has obtained a height of 6 inches.

"Three or four waterings, not too copious, are necessary, according to season. In fact, water as often as you water wheat.

"5. HARVESTING.—Flax must be torn up by the roots, not cut down. The harvesting is to begin *before* the seed is quite ripe. Directly the bottom leaves of the stalk begin to fall off, and the last blossoms have disappeared, the time of pulling has come. A *good test* is to cut a capsule right across,

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horizontally. If the seeds have changed from a milky whiteness to a green colour, and are pretty firm, time to pull has come. By not allowing the seed to ripen on the ground, a better fibre is obtained, while, at the same time, the value of the seed is not lessened; for 'it is well known that most seeds, though not quite mature when gathered, ripen sufficiently after being plucked, provided that they be not detached until dry from the parent plant, all the sap which this contains contributing towards further nourishing and perfecting the seed.' Pulling is done by *catching the plants by the heads* and drawing rather obliquely; a handful is taken up each time, and the root-ends of the handful are kept as even as possible. Six handfuls are made into a sheaf. The sheaves are set up slightly, inclining to and leaning against each other with the root-ends downwards, and allowed to stand for five or six days. In pulling, the long stalks are laid by themselves, and the short separately, so as not to mix good and bad flax together. When plucked as directed above, the flax must be stored away under cover for three or four weeks, and then the seed is to be thrashed out.

"If, however, the grower thinks that he risks the quality of the seed by plucking before the seed has ripened, he may delay the process of plucking till the stalk is yellow up to the top, and all the leaves have fallen and the seed-vessels begin to open in the sun. The plants are then to be *pulled up by the roots* and laid on the ground. Clean grassy soil answers best in not too thick rows, in order to let the sun penetrate it thoroughly. At the end of four or five days it is turned, so that the plants underneath may be dried.

"Two plans of harvesting are given above; the latter probably is the one preferable in this country.

"The thrashing out the seed must be done as soon as possible after harvest. Thrashing is done by striking the plants with smooth round sticks. When the capsules have been removed from the plants, the seed is to be trodden out with bullocks, the same as is done with wheat. After removal of the seed, the flax is to be tied up in bundles of about 6lb each; it is now ready for the process of retting or watering to be next described.

"A.—PREPARATION OF FLAX FOR SPINNING: *Steeping, retting, or watering.*—This may be done either while the flax is green immediately after the grain has been thrashed out, or when flax of superior quality is required, the plants must be perfectly dry and at least a year old before steeping. In this country, as the flax will be plucked by the end of March, it must be stacked until the rains—July or August—before steeping.

"Steep in ponds or tanks in which rain-water has collected, or ponds may be dug during the rains 10 feet wide, 4 feet deep, and any length desirable, and rain water allowed to fill in them. The flax tied in bundles, as previously described, is to be thrown into the ponds. The bundles or sheaves are not to have stones or weights on them, but every day each sheaf is turned with a pole to make the uppermost side change to the undermost. The water used must be pure, soft, and clear; well-water generally does not answer. The retting takes six or seven days, or only four if the weather be hot.

"To know whether the flax has been sufficiently steeped, the following test must be applied. Crack the stalk across the root, without breaking the fibre, and draw the latter towards the head of the stem, stripping it upwards. The fibre ought to come away easily, and should, moreover, hold together in ribbons; narrow and separate fibre would indicate the steeping to have gone too far. In short, when the skin peels easily along the stalk, the flax has been sufficiently steeped. The steeping should never be entirely completed in the water. It is best to finish by the agency of the dew. The process is to be carefully watched, and requires a little experience, so as not to under or overdo it. After removal from the water, each sheaf is set on end

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and allowed to stand for a day or two; the sheaves are then spread out on a field, pasture land, in very thin layers, to complete by the dew the retting process. This should be continued for about fifteen days. During the time the flax is spread out, it is frequently turned in hot damp weather at least once a day. If heavy rain threaten when the flax is spread, it is gathered into conical sheaves until the weather gets fine; rain soon causes it to rot. After steeping, flax should be kept five or ten months tied up in bundles, about 6lb weight each; the best qualities may be kept two or three years. When dressed (the process to be next described) immediately after steeping it is heavy; it seems to get finer by keeping. It is stalked like a heap of grass or hay with the root-ends outwards in circular fashion, with a light thatch of grass and bamboos at the top; a *pucka* flooring, or simply a layer of *pucka* bricks, will ensure safety from white-ants; of course, high ground is to be selected for stacking.

"B.—DRESSING THE FLAX: *Breaking.*—The flax having been prepared for the last process (after steeping and drying) it is subjected to these either by hand or by machinery. It may be broken either with wooden mallets or it may be still better subjected to the action of Brasier and Hodgkins' (Liverpool) patent 'shamrock' hand-breaker. This machine will break—that is, extract—a very large portion of the woody matter, leaving the fibre uninjured and ready for the last or scutching process.

"Three men are required to work it; one to work the handles, one to feed, and one to receive the broken material. It is necessary to pass each handful of fibre twice through the rollers; one and a half maunds of fibre can be worked in one day. A machine costs at Liverpool £13. All charges included, it will cost £20 (R200) to any part of India.

"*Scutching.*—The flax is now ready to be *scutched,* or made ready for spinning by this final process. There is a scutcher attached to the breaker previously described, but I find that the scutching-blades get too brittle and soon get useless by working; this may be due either to the extreme dryness of the atmosphere during the cold season in this country, or to some fault inherent in the manufacture of the blades. At all events, I found that I could not scutch by the machine. Hand-scutching was then resorted to. A scutch is a wooden knife 2 inches long, $3\frac{1}{2}$ inches deep, and half an inch thick, tapering to an edge. It is best made of *seesum* wood. A *scutching-board* is required on which to work the flax. This is an upright plank 51 inches high, 14 inches broad, $1\frac{1}{4}$ inch thick, firmly fixed in a solid block of wood. At the height of $37\frac{1}{2}$ inches from the foot is a horizontal slit $1\frac{1}{2}$ inch broad. With his left hand the scutcher introduces into the slit a handful or tuft of broken flax, so that it hangs down on the side of the scutching board; with his right hand he scrapes and chops at the flax with the scutch till all the remaining woody matter and all the broken pieces of fibre have been removed. The *long fibre* left in the hand of the scutcher is the marketable article; the shorter fibre is the tow fit for packing, &c, but not for spinning into thread. Each scutcher after he has learnt his work turns out 5 seers or 10lb of flax per diem.

"NOTE.—This memorandum on flax cultivation was drawn up by me from, *first,* some papers given me for perusal by Mr. E. C. Bradford, who had paid £20 for the information contained in them at the British consulate in Brussels; *second,* from a work on 'Flax and Hemp,' by Sebastian Delamer (Publishers—London: Routledge, Warne, and Routledge). I acted strictly in accordance with the instructions given in my experimental cultivation of flax. I sowed imported (Riga) seed and country seed: of the former 300lb were used; this quantity cost, inclusive of freight, inland carriage, R90. Of country seed $20\frac{1}{2}$ maunds were sown. This quantity of seed, 20 maunds and 10 seers, sowed 8 acres of land. Four acres were

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rented land, which was sown, ploughed, watered, &c., at my own expense. Four acres were sown for me by a talukdar. I gave him the seed; all other charges were his, and he took the seed produced, giving me the straw (fibre). The seed produce of the 4 acres cultivated by myself was 29 maunds, equivalent in money value to about R57. The quantity of flax produced and exported as the produce of 8 acres was only 11 maunds and 28 seers, less than half a ton (the ton being 27 maunds and 10 seers); this was valued and sold in London, at £23 per ton, for £9-12*s.* The produce of Riga seed, if sufficient in quantity, would have fetched at the rate of £29 or £30 per ton; the produce of only country seed was not worth more than £23 per ton.

	R	*a.*	*p.*
The experiment cost	663	0	0
The return was	253	0	0
Loss . .	410	0	0

"The rail carriage from Hurdui to Bombay was R37-14, or about R70 per ton. Freight from Bombay to England is from £2-10*s.* to £3-10*s.* per ton, according to season. There are, besides charges for pressing into bales, inland charges on landing in England, &c. The produce of 8 acres, if all the seed had been imported, would have been 2 tons, which would have fetched a higher net value in England; but, as a set-off against this there would be the higher price paid for imported seeds (*i.e.*, country seed is from R2-4 to R2-8 per maund; 300lb Riga seed cost R90, or at the rate of nearly R30 per maund), and of course increased carriage and freight on the larger quantity. The linseed as ordinarily sown and plucked by natives is *useless* for fibre, *i.e.*, from which to extract flax fit for spinning. It makes good *tow*, which, if it could by *machinery* be utilised for ropes and canvas, might, I think, prove of great value. Nor do I think pure country seed, even sown thickly in order to make the plant rise to a good height of much value. I sowed in good land, carefully attended to all the processes, but still the plants did not obtain a height of more than 19 or 20 inches; the plants from Riga seed were 2 feet 6 inches to 3 feet. The length of flax is of great importance, hence I believe that the flax from country seed will never be of any commercial value in England. What may be still worth trying is to import sufficient seed to sow about 50 or 100 acres of good land; part of the land to be sown for fibre, part only for seed; then in the next season to sow a larger area with acclimatised seed,—that is, seed the produce of the previous year's importation. The straw of two years' sowings may be worked into fibre, but not by manual labour. Machinery and steam-power are necessary, as a matter of economy, in the long run. The machinery is simple and not expensive, and I think it would be worth the while of a capitalist to try the experiment as indicated above."

The following passages in the *Journals of the Agri.-Horticultural Society of India* allude to flax in the North-West Provinces and Oudh:—IX., pp. 371-379 (Report by Mr. C. Gubbins on flax raised at Allyghur from foreign and native seed); XI., pp. 514-531 (correspondence regarding the cultivation of flax in the North-Western Provinces); continued pp. 593-613; Proceedings, 1860. cxi.; XIII., (Proceedings for 1864) report on samples prepared at Shajehanpore.

IN THE CENTRAL PROVINCES.

IV.—CENTRAL PROVINCES.

The Chief Commissioner of the Central Provinces reported, in reply to the Government of India's Circular letter, that flax was cultivated exclu-

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sively for its seed, and that it was always short and bushy, seldom exceeding one foot in height.

"Captain MacDougall, Honorary Secretary of the Nagpúr Agricultural and Horticultural Society, wrote that wherever the plant is raised in that locality, thick, indeed immoderately thick, sowing was the rule which is the reverse of the practice in North India, and that the exception will only be met with at headlands of fields, where the individual plant, having air and room, tillers out and becomes bushy.

"'Again,' he continues, 'the inference to be gained from Mr. D'Oyly's wish to see thick sowing followed in order to gain fibre—namely, that the plant will run tall and thin—is refuted by the habit of the plant, as seen in our fields. Nowhere does the present system of thick sowing produce plants more than a foot in height, with perhaps five or six seed capsules.'

"Captain MacDougall, moreover, differs from all the opinions expressed as to the kind of soil which is most suitable to the growth of flax. He observes that it is plain that there is a great want in the plants grown in the Central Provinces of that woody tissue which constitutes the strength of the bark, the portion from which the flax would be scutched; and he attributes the want of this tissue to the plant being grown in the stiff black clay of the cotton soil, which, unless well stirred up and rendered friable, would prevent its roots permeating downwards into the subsoil and there gathering nourishment. He also gives another reason, *viz.*, that the plant is solely treated as a *rabí* crop instead of as a late *kharíf* one. 'Treated as a *rabí* crop,' he argues, 'the plant has not as good a chance of nourishment as a late *kharíf* crop would ensure. If during the cold weather there are heavy dews and occasional sharp showers of rain, such as sometimes fall about the Dewali and Christmas, the crop gains something; but still this is hardly sufficient, for the soil does not absorb the quantity of water thus given to any great depth, and the roots (unless it is a good free soil) have still to struggle hard to get downward to meet the moisture stored up in the subsoil. The result of the present system of cultivation is that the roots, from want of a nice, light, and free bed remain near the upper surface, and the life of the plant never exceeds four and a half months.'

"In order to gain a satisfactory result, this is what should, in Captain MacDougall's opinion, be done: 'If patient attempts are persistently made year by year to change the habit of the plant, and we could succeed in sowing it on well-ploughed and manured land in August with its life prolonged to February, I feel confident we should find a marked improvement both in flax and seed-bearing properties.'

"Captain MacDougall cannot quite see the cause of the alarm as to the effects of thin sowing expressed by Mr. D'Oyly; and he says that a plant can tiller and yet give shoots. He compares the flax-producing plant to wheat, and observes that a single seed of the latter sown in good soil will give five and six (if not more) stalks, each of equal length, strength and productiveness.

"The Chief Commissioner, referring to the allusion made by Mr. D'Oyly in paragraph 13 of his report to certain experiments made by Mr. J. B. Williams in the Jubbulpore District, says that they have been discontinued, and practically they did not result in much. This gentleman, it seems, who for many years was in charge of the Thuggy School of Industry in that district, prepared the fibre, but had no idea of its commercial value. His fibre attracted notice in Calcutta, thanks to his having to send some valuable glass-ware to the care of Messrs. Colvin, Cowie & Co., which he packed with this fibre. It appears that Mr. Williams even received orders from a Calcutta firm to supply any quantity he could.

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But no account is given as to the particular manner in which these plants were cultivated, nor is it stated what the length of the flax was when prepared. Mr. Williams' business was subsequently purchased by Messrs. Maclean and Warwick, but it is not known whether this new firm still carries it on.

"An ex-partner of Mr. Williams' (a native) writes that the '*gundy sunn*' produced in Jubbulpore used to be purchased by them in co-partnership and forwarded to Calcutta, and that sometimes a little used to be shipped to England.

"In the publications of the Agri.-Horticultural Society no mention is made of Flax in the Central Provinces, though several papers deal with Linseed (see below).

IN BERAR.

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V.—BERAR.

The Resident at Hyderabad transmitted to the Government of India the reports contributed by the local officers of the Assigned Districts.

The Officiating Commissioner of West Berar (Major J. G. Bell), for example, wrote:—

"In this division last year it was estimated that 162,693 acres of land were under oil-seeds, of which a large proportion may be taken to be linseed. An acre of good land in a good season is estimated to produce 250 seers of linseed, and the average price in 1869-70 was from ₹18 to ₹20 per candy of 540 seers. In 1872-73 the prices, it is said, rose to ₹65 per candy. Linseed is chiefly grown for the sake of oil, for the purpose of extracting which it is mixed with the *kurdee* seed (Carthamus tinctorius). The stalks of the linseed plant are thrown away or burnt, though occasionally they are used for thatching huts.

"The Assistant Cotton Commissioner, East Berar, reported that the rich and loamy soils in the Purna valley will be best adapted for cultivating flax, and also such lands as are subject to inundation by the waters of the Purna and Wurdha rivers. He adds that *ulsee* is now grown on the best and cleanest lands, but that he is unable to say whether flax cultivation would pay better than *ulsee* (linseed), and he is therefore desirous of growing some seed on an acre or two of land in the Purna valley.

"The Resident states that it appears that, although flax is cultivated to some extent in those districts, it is chiefly for the object of extracting oil rather than for the manufacture of fibre.

"This preference of the people for the extraction of oil is attributed to the shortness of the stems, as well as the greater expense and trouble of converting them into flax as compared with hemp [Crotalaria?—*Ed.*]. The Resident states, moreover, that cotton, *jowari*, and wheat are the staple products, and that so long as the rayats find these more profitable than any others, there is but little hope of flax being taken up by them willingly for more extended cultivation than at present obtains. On the receipt of the circular a plot of land in the model farm at Akola was sown, however, with flax by way of experiment, and a communication on the result of this trial was promised in due course. But, as the farm has since been abolished, it may be inferred that the experiment came to nothing.

"The Resident expresses his readiness to give effect to any general measure which the Government of India may direct in view to the extension of the cultivation and manufacture of flax in Berar."

In Vol. X. of the *Journal of the Agri.-Horticultural Society of India* (p. 97), Captain Ivor Campbell states that he forwarded, in 1856, a sample of flax and coarse cloth made of it which he had prepared in North Berar. He then writes: "Although this district furnishes a large proportion of the linseed which is exported from Bombay, and last year there were more than 100,000 *bighas* of land under the cultivation, the people were not aware

that the plant, which is sown wide apart, for seed only, produced any fibre."

CULTIVATION IN BOMBAY.

VI.—BOMBAY.

The Government of Bombay submitted a summary of information which had been furnished by the Commissioner in Sind and the Revenue Commissioners of the Northern and Southern Divisions of the Presidency, in reply to the Government of India's Circular letter on the subject of Flax:—

"In Sind no flax is grown except in the Upper Sind frontier district, where flax alone is grown to a very limited extent for local use only, the zemindars making ropes from it. Two acres would cover the whole area grown annually for the whole district.

"The Collector of Karáchi, in 1869, obtained 11 maunds and 3 seers of linseed from Fleming & Co., and distributed it among fifty-three different zemindars in the Sihwan taluk. The result was not very successful: the average produce was threefold; in some cases it was thirty-one times the amount of seed. The Collector attributes the failure of the crop to inattention and ignorance on the part of the zemindars, but considers that an experiment conducted at the Hola Government farm could not but have good results.

"In Belgaum and Kanara flax is grown to a very limited extent.

"It is reported by the Collectors of Poona, Dharwar, and Belgaum to be used in making cords and ropes; oil is extracted from its seed, and the refuse is turned into cakes for cattle.

"*Northern Division.*—In this division flax is grown to a limited extent, oil being extracted from the seed for local use. But nowhere is it grown for the sake of the fibre.

"The Government of Bombay also forwarded two letters from Mr. W. F. Sinclair C.S., Assistant Collector, Kolaba, containing his observations on the possible development of the production of flax in that Presidency and the preparation of the fibre. In acknowledging the receipt of these letters, which are given below, the Government of India expressed a hope that His Excellency the Governor in Council might find it practicable to extend some encouragement to Mr. Sinclair in carrying out the experiments he proposed to undertake."

The following passages from Mr. Sinclair's letter are of considerable interest, and may, therefore, be reproduced here:—"The flax plant (Linum usitatissimum) is very largely cultivated in Khandesh, and also, I believe, in Násik and Nuggur. The linseed alone is used; the fibre, which is useless as fodder, is thrown away. It is obvious that, since it pays to cultivate the crop for the sake of the seed alone, a very small success in utilising the fibre now wasted would be profitable. I may remark *aliter* that hemp also is much cultivated here without regard to the fibre; but that of our Indian variety has been, I believe, proved by experiment to be of little value. The contrary, I think, is the case with the flax. The plant is short and branchy, unlike the long single stem of that raised in Europe from seed chiefly furnished by Russia and Belgium. (Ireland produces no linseed; England little for agricultural purposes, the climate being unfavourable.) The Indian flax, therefore, is what cotton merchants call short in staple; but it is not deficient in tenacity, and would be worth, if properly prepared, at least £25 per ton in the Irish market. The present lowest price is £35 to £40 per ton, so I have allowed a good margin.

"It may be worth while to describe the Irish process of preparing flax. The plant is pulled up by the roots when the seed is nearly ripe, steeped in water for some time, and then rolled or beaten to break up the pith. It is next scutched, *i.e.*, submitted to an action like that of loosely-set

CULTIVATION. Bombay.

scissor-blades, whereby the fibre is cleared of the broken refuse, called '*shoves*.' It is now 'flax,' and ready for the market, where it is purchased by the spinners. These, by processes which I need not describe, convert the finer sorts into 'line' for the manufacture of cloth, and the coarser into 'tow,' which is made up into cordage and sacking. To the latter class the fibre now producible in this Presidency would belong.

"The object which I have in view is the production of coarse 'fi *i.e.*, the article 'scutched,' and ready for the manufacture of tow. require, first, water; secondly, the means of breaking and scutchi These operations are performed by steam, water, or hand-power. T very transformation which I wish to effect, *viz.*, that of the production linseed alone into a combined trade in linseed and flax of inferior qualit (for it has not been found possible as yet to save the seed, when the plan is plucked early to secure the finest fibre), is now going on in parts of England by means of small sets of machinery, which cost about £2,00 to set up there, and could hardly, I suppose, be brought into operation he under a cost of ₹40,000. But, after a careful enquiry into the history of the attempt made to set up a flax trade in the Panjáb, I am decidedly of opinion that the use of extensive machinery is in our case to be avoided.

"In the Panjáb, first-rate machinery, skilled labour, and Riga seed were imported. The article produced was at the top of the market, but the production was insufficient to keep the machinery going. The Belfast men got tired of waiting for profits, and the Government of advancing subsidies; the chief manager died, I think, and the whole concern rotted away, after a fashion not unfortunately outside of our own experience in industrial enterprise. The matter had been pushed too fast, and without regard to the caution of the rayat in venturing upon any new thing before he feels the ground firm under his feet.

"Upon understanding these things, I turned my attention during my leave, which was spent in the flax districts of Ulster, to the process of hand-beating and hand-scutching These are chiefly performed by women; the former with the 'beetle' used in cookery (which would be efficiently replaced by its Indian representative, the *musal* or rice-pestle), and sometimes, where horse-power is available, the flax is rolled in a machine exactly like our Indian *chunamchakar* or lime-mill. The hand-scutching is done with tools that any village carpenter could make out of a two-dozen claret case, and so small that I brought the most important out with me in my portmanteau. The fibre, however, is inferior to that which is machine-scutched.

"I am certain that at a slight expense in tuition the rayats could be taught to use these tools and prepare an article saleable in Belfast and Dundee at remunerative prices; and that when at the end of a few years the trade had taken root, the time would come for the importation of seed and the erection of machinery, which could in many cases be set up in the cotton-ginning mills already in existence. No steam machinery is better fitted for use in India, because scutchers can 'fire up with *shoves*,' *i.e.*, depend chiefly upon their own refuse for fuel. I should add that they are more in danger from fire than most other trades, and can seldom effect an insurance.

"The process of production would be shortly as follows: After pulling, the flax would be rippled, *i.e.*, stripped of its seed by hand or by pulling it through a 'rippling comb,' which consists of a set of iron teeth set upright in a block. The seed would then be laid out to finish ripening, and the 'reed' or stalk stacked till the monsoon (flax is a *rabi* or cold-weather crop), when it would be steeped with proper precaution against the pollu-

in Bombay. (*G. Watt.*) LINUM usitatissimum.

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Bombay.

tion of rivers by the poisonous 'flax broth,' broken and scutched by the cultivators' wives, and pressed or half-pressed, like cotton, for export to Belfast or Dundee, from both of which places I have valuable assurances of interest in the matter.

"At present the flax supply is diminishing in Ireland, from the high price of labour and the rapid conversion of arable land into pasture, which is the main feature in the phase of agricultural progress through which that country is now passing. I have the high authority of M. Emile de Laveleye for the fact that the former cause is producing a similar effect in Flanders. Of Holland I do not know. Russia produces much fair flax; Egypt some very bad and some very good. I am promised details with regard to the last-named country, and shall in the meantime be glad to answer any reference Government may please to make upon the subject, and to put my information and materials at the disposal of any officer who may feel inclined to take the matter up. I should propose the despatch of samples of this year's crop to England for examination, and the engagement of hands to teach the scutching for a couple of years."

Mr. Sinclair's further letter ran thus:—"The technical vocabulary of the flax trade is as follows:—

"Flax" means, firstly, the whole crop; secondly, the fibre after it has been scutched, in which state the spinners buy it.

"Linseed" or "seed,"—the seed.

"Reed,"—the stalk, of which the fibre is the outer part.

"Rippling,"—the separation of the seed from the reed.

"Scutching,"—the separation of the fibre from the pith.

"Breaking," "rolling," or "beating" is the operation of preparing the flax for scutching which is done either by mere pounding or by passing between rollers at a high pressure.

"'Shoves' are the broken refuse of pith and bad fibre which remains after scutching. In Ireland this refuse is generally used as fuel; but the Dundee men work it up into sacking, and it is also much used in making roofing-felt.

"'Retting' is the steeping of the flax in water to facilitate the separation of fibre from pith.

"'Beets' are the bundles or sheaves in which flax is tied up for the retting.

"'Scutching handle' is a wooden tool about 28 inches long, 4 inches wide, and 1lb in weight. It is bevelled off at the edge

"'Scutching-block,'—a plank set up on edge and so bevelled above as to correspond to the scutching-handle. It is nailed to a block, stool, or table, to keep it steady. The bundle of broken flax is held in the left hand over its edge, and turned and exposed to sharp drawing cuts of the scutching-handle, which separate shoves from the fibre. The bevelled edges of the block and handle are turned away from each other during this operation.

"So effective are these simple instruments that those worked by steam differ from them very little in shape or application

"I would suggest that the model farms might, if they conveniently can, send in each six samples of 1lb a piece, *viz.*, three of untouched straw and three of flax cleaned, the best way they can. A *chattiful* of any water (not containing lime in solution) would steep 3lb of flax very easily. A few blows of a rice-pounder, or passing it under a *chunam*-mill or garden-roller, would break it, and some primitive attempt might be made at scutching so small a quantity. If the model farms think they cannot manage it, and will send me the flax, I will try it. The test of sufficient steeping is a green slime which comes off easily between finger and thumb;

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that of sufficient dryness after steeping is the 'bowing' off the fibre, *i.e.*, its beginning to separate from the reed and form loops or bights along it. It is then ready to break and scutch.

"If we had these samples, they could be examined by proper authorities, and some estimate (though very rough) might be formed of the improvability of the native crop. Any particulars as to the average yield per acre of seed would be valuable, as tending to show what effect the importation of seed might have upon the oil trade.

"I can, if these views meet with concurrence, at any time furnish the addresses of firms who will be glad to examine samples, or answer any further reference that may occur to Government or to any officer concerned."

IN MADRAS. 406 E9

VII.—MADRAS.

The Government of Madras submitted a copy of its proceedings, containing the information supplied by the Board of Revenue of that Presidency which had been compiled from the reports of the district officer, under its control. In these proceedings morespace is devoted to *gánja* or hemp, and *sunn* (Crotalaria), than to Flax. That portion of the communication which concerns flax is given below:—

"This plant is not cultivated in any of the following districts:—Vizagapatam, Nellore, Madras, Tanjore, Trichinopoly, Salem, South Kanara, and the Nilghiris, and is not mentioned in the reports from Coimbatore and Tinnevelly. It is grown most extensively in Bellary and the Kistna (total 10,500 acres). Linseed-oil is extracted from the seed and used by painters as well as medicinally; the seed, not the oil, is also exported to England. The plant is not used for its fibre, but the leaves when young are used in curries."

In Vol. IX. of the *Journal of the Agri.-Horticultural Society of India* (pp. 321 to 335) Dr. John Mayer, Professor of Chemistry in Madras, during 1856, contributed an analysis of the mineral constituents of the Flax plant, and of the soils on which the plant had been grown. The analysis had been worked out by himself and the late Professor D. S. Brazier of Aberdeen. As the results obtained by these chemists are frequently quoted, the reader is referred to the original article in the volume cited above.

IN MYSORE. 407 E9

VIII.—MYSORE.

The Chief Commissioner of Mysore furnished the Government of India with a report prepared by Colonel Boddam, in whose opinion no part of the Mysore plateau was suited for growing flax, either for fibre or linseed-oil, because it required a colder climate and more copious dews to bring it on than they have in Mysore. He also stated that he had not seen *ulsí* grown anywhere south of Nagpúr;* that there it was sown at the beginning of the cold season (about November), in fields, at the same time as the wheat crop, on rich black cotton-soil; and that slight showers, which usually fall in that locality in November, start the crop, which is fostered by the heavy dews of that part of the country, while the cold is greater than in Mysore. He also observed that heavy rains ruin the crop, stripping off all the delicate leaves; he then continued,—"Knowing the value of linseed-oil for cattle fodder, I tried some two years ago in my garden; in the rains the leaves were stripped off, and the plants perished; in the cold weather it grew stunted, and, after giving a few flowers, died prematurely." Colonel Boddam concluded by suggesting that if an experiment were to be undertaken at the Lall Bagh, the seed should not be sown

* Nevertheless it is grown in Madras Districts, a good way south of Nagpur.

before the middle of November, to avoid the heavy rain usual in October and early in November.

CULTIVATION IN BURMA.

IX.—BURMA.

"The Chief Commissioner of Burma reported that there was practically no flax cultivation in that province, but that it was grown to a very small extent here and there for the seed, and to a larger extent in Upper Burma. He asked for seed, so that he might be able to endeavour to introduce the cultivation of the plant into the province.

"Twelve maunds of good selected seed, purchased through Messrs. Moran & Co., were sent to him on the 6th instant, and it was suggested that he should try the experiment in four different localities, an acre being cultivated in each; that the ground should be selected at once, and properly prepared for the reception of the seed before the commencement of the sowing season, care being taken that the cultivation be conducted under such ordinarily favourable conditions as attend the growth of a crop by a cultivator interested in its success. He was also asked to note the cost of cultivation, and to submit a full report of the results of the experiment in due course.

"A pound of flax seed imported from Melbourne was obtained from the Agricultural and Horticultural Society of India, and was also sent to the Chief Commissioner for trial in the garden of the local Society or in some other suitable locality, the proceeds of the cultivation being compared with that of the indigenous seed." The results of the experiments carried out in accordance with the above arrangements, are noted below.

Two bags of the seed were sown at Zanganung in May 1875 by Mr. Hernandez, of the Burma Company, but resulted in a complete failure owing to the lateness of the sowing on a soil insufficiently prepared.

In Thayetmyo the experiment was entrusted to Surgeon-Major Lamprey, of Her Majesty's 67th Regiment. The seed, which was reported by him to be of a very fine quality, with a large and sound grain, reached him in September 1874; but owing to the unusually high rise of the river Irrawaddy in the month of October, and its late subsidence, it was not possible to sow it before the close of December, when the soil of the bed of the river was capable of being ploughed. The seed was sown over an area of one acre, and after six days had elapsed germination was apparent At first its growth was promising, but subsequently the growth seemed to be arrested, and the plant did not obtain a greater length than 14 inches, including the root fibres. It began to seed two months after sowing. The yield was not in proportion to the quantity sown, as it was barely in excess of that. Dr. Lamprey was of opinion that the seed would yield good oil, and stated that from a trial made in the hospital it was shown to be equally good, if not superior, to the linseed generally supplied by the Medical Stores. He was unable to obtain fibre from the plant, as the fibre was barely traceable and the inner portion of the stem was hard and woody in texture. In his opinion the conditions of the soil and climate did not seem suitable for the cultivation of the plant in the Thayetmyo district. One great obstacle to its cultivation was the growth of grass (*Kaing*), and on that account Dr. Lamprey strongly recommended the importation of English agricultural implements to ensure good results with experimental cultivations in the province.

In the Amherst district, no success attended the cultivation of the flax. The plant after growing to a certain height withered, but it was affirmed that the lateness of the season in which it was sown formed an obstacle to its growth. In Tavoy also the experiment was unsuccessful, the climate being considered unsuitable for the description of flax. Similar unfavourable

CULTIVATION. Burma.

results attended the experiments at Meday, Kama, and Mindoon, and at the jail at Thayetmyo The attempts to cultivate the seed all failed.

In the Shwegyeen district the seed was apparently sown with a crop of wheat. The plants from this sowing were reported by the Agri.-Horticultural Society of Rangoon (to whom dried specimens were sent) to have been of a fair average height and to have seeded plentifully.

A more satisfactory result was obtained by Captain Poole, the Assistant Commissioner of Myanoung. "Of a bag containing 100lb, half the quantity was sown in the jail garden, there being no room for more. Four pieces of ground were selected, aggregating nearly one-twelfth of an acre, which had been previously well dug up and manured for the cultivation of vegetables. The four plots did not differ much in situation, except that one was a little lower than the others, and therefore more constantly under water during the rains. It was observed that the plants came up more quickly on this spot and that they looked stronger and better than the rest. The whole of the jail garden was rich clay; it was very fertile and an abundant supply of vegetables had been produced for many years. The site selected was apparently as favourable to the growth of flax as could have been chosen. The first sowing was on the 1st October 1874, the plants came above ground in ten days. A second sowing took place on the 16th, the plant appearing in five days. This was on the low ground before alluded to.

"In January the flax flowered, and in March 1875 the plants were gathered. About 220lb of seed were obtained and kept for subsequent sowing and for distribution to cultivators. There was unfortunately no one connected with the jail who had any experience in the preparation of the fibre, and consequently the Burmese method was adopted. The stalks were steeped in the river for five or six days and then taken out and dried, the fibre was then pulled off by the hand until nothing but the stalk remained. The gross quantity of the fibre obtained was about 30lb in weight: it was beaten out with a wooden "lutel" as in Ireland, and an attempt was made to spin some of it into thread, which failed. A small portion was made into rope and some also forwarded to the Rangoon Jail. Captain Poole strongly recommended more extensive cultivation of the fibre, as, in his opinion, the greater portion of the land in the province was suitable to its cultivation. He was also of opinion that there is nothing to prevent superseding the comparatively valueless production of crops known in the Burma revenue nomenclature as miscellaneous or *piné* cultivation. The enhanced value of the produce of the land would, he thought, amply justify an increase of the revenue on such lands." Whether Captain Poole's suggestion was ever carried out and was attended with the success he anticipated, the writer, from the imperfect data before him, is unable to say.

The pound of Melbourne seed, which was sent to the branch of the Agri.-Horticultural Society at Rangoon for experimental trial, was sown in November; the plants came up but sparsely, and had scarcely grown a foot in height before they came into blossom and began quickly to perish—being scorched up under a November's sun. In December five or six beds were planted with the Bengal seed which did better, and although not a success, since the plants did not grow above a foot in height, when they all flowered, the experiment was not altogether a failure, as a quantity of seed was gathered from the crop. Mr. Hardinge, the Honorary Secretary of the Society, mentioned that there was not the slightest difference between the plants raised from Bengal and Melbourne seed; that apparently the climate of Rangoon, when even at its coldest, was not favourable to the growth of the flax-plant with success, but that where greater cold is experienced, it would probably thrive better.

in Bengal. (*G. Watt.*) LINUM usitatissimum.

X.—BENGAL.

CULTIVATION IN BENGAL.

The proceedings of the Honourable the East India Company (to which reference has already been made) contain the financial and other results of the two experiments made at the close of the last and during the first two decades of the present century, with the object of introducing Flax cultivation into Bengal. These show that the attempt to introduce Bassorah Flax into Bengal and the North-Western Provinces failed. It appears from the correspondence that Arabian Flax cultivators were brought from Bassorah and flax seed was imported thence, but the final conclusion arrived at was that the soil of India was generally unfit for the cultivation of Flax and that the Arabian method of dressing the fibre by "beating" and "scratching" was so very tedious when compared with that used in England by "breaking" and "swingling" that if the cultivation were ever introduced in India on an extensive scale there was no doubt that the latter method of dressing should be adopted. The passages quoted above (pp. 11-24) from Royle's *Fibrous Plants of India*, exhibit the success or failure that attended the efforts (mostly of private individuals and mercantile firms), which were made to continue the efforts at establishing the new industry, down to about the year 1843. Some thirty years later Mr. D'Oyly's report once more reopened the enquiry, and the information collated on the basis of his essay has been briefly reviewed in the provincial notes above. Apparently Bengal contributed nothing further than Mr. D'Oyly's high expectations, and the subject may be said to have once more lapsed into obscurity.

The following references to the publications of the Agri-Horticultural Society may be cited as having a bearing on Bengal:—Vol. I. (1842), p. 393. Mr. Deneef's "Practical information on the best mode of cultivating Flax in Bengal" (see p. 16 above); the details of the Chittagong experiments, Vol. II., pp. 275-281; the Monghyr experiments, Vol. III. (Proceedings), p 49; in Vol. VI. (New Series, 1878), p. vii. Mr. R. Macallister reported despatch of samples of Flax grown in Mr. Lethbridge's Indigo plantation at Otter in Tirhoot. High expectations were entertained by Mr. Macallister of the advantages of a combined Flax and Linseed cultivation if undertaken by the planters who have the means of sowing good seed thick, so as to encourage the formation of fibre as well as seed. The Secretary of the Society in commenting on Mr. Macallister's samples reviewed all the papers that had appeared on the subject, and then added: "None of these numerous experiments resulted successfully in a commercial point of view, though the produce was, in many instances, favourably reported on, as it could not apparently compete in the home market with the produce of Europe. Flax, for fibre, cannot, it is feared, be profitably grown in Lower Bengal; now, however, that a local demand has arisen for it, and the attention of indigo planters and others has been attracted to its cultivation and preparation, there is a fair prospect of success attending the renewed endeavours that are being made for the growth, for its fibre, in Upper Bengal, of this useful and valuable product."

Shortly after the date of the above correspondence in the Agri.-Horticultural Society's Journal Mr. Macallister published (1877) a note on Flax cultivation in India, from which the following passages may be extracted as conveying the new facts or suggestions which Mr. Macallister offers, and which, perhaps, have not been sufficiently urged in the above review of past literature of Indian Flax:—

"The common linseed stalk of this country, which is usually thrown aside as useless by cultivators after they have extracted the seeds, although short in fibre in consequence of thin planting and poor soil, can be made available for a fairly good class of fibre, if the stalk can be got out of the

CULTIVATION.

Bengal.

producer's hands before the exposure to the sun and hot winds has spoiled it. In the Mississippi and Missouri valleys of America, large quantities of linseed (flax seed) are annually planted with a view to utilise both seed and fibre, and both are utilised to the fullest extent with much profit to the planter. The quantity of seed put into the ground is about treble that in Bengal, consequently they not only get a good fibre, but obtain a better yield in seed. Machines patented by F. A. Smith, Esq., of the Missouri Flax Works, High Point, Moniteem Co., Missouri, U. S. A., are used for threshing out the seed. Where labour is high, as in America, these machines are indispensable; here, with the cheap labour of the country, the usual method of threshing rice, *not the bullock tramp, because that spoils the fibre*, but the usual threshing by hand over a log of wood, or a stone, is the best. The fibre produced from native-grown linseed, although much inferior in quality to that grown, especially with reference to fibre, is nevertheless a fair substitute for Russian tow for all sorts of coarse goods, and if carefully worked out will fetch in the London market from £25 to £35 per ton according to quality.

"Good Russian Riga flax is now worth in the Calcutta market about ₹550 per ton, or ₹20 per Bengal maund. Indian flax can be produced nearly, if not quite, as good as Russian, and much cheaper; so that if, as I believe, numerous indigo planters are prepared to try a few acres, specially grown on prepared lands, and worked out with a view to better quality, as also to utilise their ryot's productions for the coarser quality, we are likely to get a long way on the road to success without much delay, and eventually to enrich the agricultural resources of the country to an important extent Indigo planters especially would benefit by adopting flax raising as an auxiliary to indigo, as there need be no great outlay; they have engines, vats, and buildings; they have generally at their command the raw material, and can grow it for fine qualities; and what is of more advantage than all, the manufacture of this fibre serves at a season when they have little else to do.

"I have written the above rough remarks with a view to convey to others who are desirous to benefit by it such knowledge as I have gained from considerable experience, both in America and India. I have found in experiments, carried on at Dinapore during the past season, that Indian linseed straw grown by the native cultivators is rich in fibre, but, owing to the mode of growing that fibre, is harsh, and that when planted thickly and grown for fibre only, the fibre is almost equal to Russian. Cultivators who wish to make the most out of their labour would do well to plant double the usual quantity of seed to the acre, gather the stalk when the seed in the bolls is ripe or the bolls have turned brown, thresh out the seed after two days' sun, and immediately immerse the stalks in water and follow the process above stated. Thus, they will utilise the seed, and get a fibre useful to the mills, both here and in England, for making canvas for ships' sails, tarpaulins, &c., for which there is a large demand. The Rustomjee Twine and Canvas Factory at Ghoosery, near Calcutta, have this season manufactured from imported flax more than 300,000 yards of sail and paulin cloth, for which purpose this fibre would serve admirably. Producers will now find a market for their productions here in India."

No further reports have been published regarding the Tirhoot proposals of a combination of Indigo Flax cultivation—the most recently awakened interest in Flax—and it is thus feared, that, like all the other hopes and expectations raised during the past seventy, eighty, or hundred years, the subject has lapsed, once more, into the oblivion, from which, spasmodically, it has been rescued, through a consideration of the millions of pounds sterling

which it is thought are annually lost owing to the people of India neglecting to utilise the stems of their linseed crops.

Paper Material.

PAPER MATERIAL. 52. 410

It has recently been urged by the European Press that linseed cultivation has many advantages to the English and Scottish farmers. That although it is known to be an exhausting crop and hence is barred by many leases, an effort should be made to overthrow these objections through manuring. The reasons for this recommendation are, that the seed would give a fair return which, if combined with the proceeds of the sale of the uprooted stems (after being dried by stacking on the field like corn) would make the crop highly remunerative. These dried stems, it is urged, would, afford one of the best of paper materials. They would require no preparation, as fibre and wood could be pulped together. It is further pointed out that fowls fatten or lay marvellously if allowed to stray over a linseed field and they do little or no harm; while, according to the Russian peasant's experience, a certain percentage of linseed or linseed-cake given to cattle is the best food-material for causing a prolonged yield of very superior butter-yielding milk. Cattle so fed afford also the finest known manure, so that if this be applied to the field, the injury caused by the crop is more than compensated for by the numerous advantages to be obtained from a limited linseed cultivation on each farm.

The idea of utilising the Indian Flax stems as a paper material has more than once before been urged. With Esparto and other valuable grasses at their present cheap price, it is admitted, however, that the paper-maker cannot afford to pay for a fibre that requires to be prepared before being thrown into his vats. He can thus purchase the jute cuttings and ends, also old bags, ropes, and rags, but cannot afford to purchase new jute fibre, though jute is the cheapest of all fibres. But in the case of flax stems, as above recommended, no previous preparation is considered necessary. The objection urged by the native cultivators that a fibre-yielding linseed affords them an inferior oil goes for nothing. They are also not called upon to pluck the crop at a season more favourable to the fibre than the oil. They are not called upon to take measures to prevent the fibre being injured by exposure to the sun, nor are they required to learn a new industry, that of crudely separating the fibre from the flax stems. They are simply asked to dry these stems and sell them thus to the paper-maker rather than burn them as manure. Everything would thus seem to point to paper-making as the best channel of utilisation for the Indian linseed waste stems. But the linseed fields of India are, as a rule, far removed from the paper mills. The means of converting such stems into paper are peculiar, and a mill would probably have to be specially arranged before it could use linseed stems. And if this be so, most paper-makers would require some guarantee that the material would be forthcoming in sufficient quantity and at a sufficiently low rate. If it had to be carried by railway, for any distance, it would very likely be rendered thereby too expensive for the paper-maker and it would certainly never pay to export the Indian crude stems to Europe as a paper material.

Separation and Preparation of Flax.

Separation. 33 411

It seems unnecessary to deal with this subject in a separate section. Flax can hardly be said to be produced in India, and the best methods of cultivating the plant, the seasons of sowing and reaping, and every detail of the manipulation of separating and preparing the fibre for the market, have already been dealt with in the pages above (see pp. 16, 31-34, 40-44, and 47-50). Detailed information regarding the machinery employed in Europe, both in cleaning the fibre and in weaving it, will be found in *Spons' Encyclopædia.* The special report drawn up by the Royal

SEPARATION OF FLAX.

Society for the Promotion and Improvement of the Growth of Flax in Ireland, gives details of cultivation and manufacture. This will be found in Vol. IX., *Jour. Agri.-Hort. Soc. India (Old Series), p. 60.* In that volume also the Secretary of the Society published a series of most valuable papers on flax culture and manufacture, thus bringing together a mass of material which should be carefully considered by persons who may desire to once more renew the enterprise of flax culture in India.

LINSEED.

LINSEED.

The seed obtained from the cultivated plant—**Linum usitatissimum**—is known as Linseed or Flax-seed, the expressed oil as Linseed oil, and the cake as Linseed-cake. The history of the cultivation of Linseed in India has already been alluded to briefly, so that it but remains to bring together in this place such information as is available on the provincial cultivation and utilisation of the crop. The writer is, however, conscious that the material at his disposal is of so meagre a character that all he can hope to do is to indicate the plan upon which future facts might be collated by exhibiting the various headings into which the subject might be divided. The passages quoted (from a wide series of publications) manifest more than anything else the imperfect and disjointed state of the information that exists in India on this, one of our most important crops.

RACES.

Races or Forms of Linseed.

To a certain extent the cultivation of Linseed has already been indicated by some of the remarks regarding Flax. The object being to promote flowering, not the production of long, straight, fibre-yielding twigs, the seed is sown much thinner than is generally the case in European flax cultivation. The result of this has been to develop several well-marked RACES, all of which possess one character in common, namely, the formation of a short, much-branched stem. Nothing definite, however, can be written regarding the forms of Linseed grown in India, since they have not been carefully worked out by botanists; but there are two important kinds, white-seeded and red-seeded, and within each of these divisions there appears to exist two forms, "bold" and "small," commercial terms that denote the character of the seed. The latter kind may, to some extent, be merely a consequence of imperfect cultivation, or of season of collection. The subject is too little understood, however, to allow of any definite inferences being drawn, but the white and red-seeded races seem perfectly distinct. It would, in fact, appear undeniable that a crop which has been cultivated for several centuries (if historic evidence be accepted), under the most diverse conditions of climate and soil, must have by now developed widely different races. And if this be so, it may safely be added that until the characters of these races have been established, it would be hopeless to expect the industry to divert at command from linseed to flax production. We must first establish the local influences and their effects upon the existing crop, and know, too, whether that crop manifests a favourable tendency to fibre formation, before the recommendation be offered that thick sowings should be made with the object of obtaining combined flax and linseed. This seems to have been the key-note of past failures. Foreign seed was forced on the cultivators—seed that often failed to grow at all, in certain of the districts in which it was arbitrarily sown, or which, where it did germinate, yielded a slightly better fibre but worse oil than the local stock. Disappointment, followed in time by antipathy against the new crop, was the not unnatural consequence. It would seem that to make flax cultivation gain a hold on the people of India, it must at first be a bye-product to seed cultivation. If the difficulties of locally cleaning the fibre, or of transit from the fields to cleaning mills, were once overcome, and it was

found that the waste stems yielded a certain return, there would then be no difficulty in inducing the people to sow thicker in order to ensure both crops. In time they might be even educated to cultivate flax only, but at present failure is certain to follow any experiment that has professedly for its object the cultivation of flax and not of linseed. It would thus seem the natural course to thoroughly investigate the nature of the Indian races of *Linum* with the object of discovering those that manifest a tendency towards fibre production. With thick sowing and careful cultivation such forms might even be educated to produce both crops, and in this way a modified flax production might gradually be inculcated into Indian agriculture Spasmodic efforts to acclimatise highly prized European and Australian forms of flax are certain to have the same fate as the experiments already made. The path most likely to lead to success in the case of this staple of our trade, as with all the products of India, would seem to be careful study and selection of the indigenous stock.

RACES.

The following jottings regarding the red and white-seeded forms may prove useful.

Red Linseed.
36 414

RED LINSEED.—There are several forms of this recognised in the trade, and these are apparently caused by soil or methods of cultivation. The season at which the seed is collected and the freedom of the plant from blight has much to say to its character, far more perhaps than the existence of distinct races, but, as already stated of this subject, we possess no definite knowledge. It is, however, admitted by most writers that the seed of one part of India is richer in oil than that of another, and it, therefore, seems probable that the drying property is equally variable.

White Linseed.
37 415

WHITE LINSEED.—The earliest detailed notices of this form occur in the *Journals of the Agri.-Hoticultural Society of India.* Thus, in 1844, Colonel J. B. Ouseley sent a sample to the Society from the Nerbudda Valley. This was examined and reported on by Henry Mornay (*Vol. III., Selections, 98*) who wrote, "This beautiful seed is larger and plumper than the finest red seed, besides which the shell or outer cuticle is much thinner, which is very beneficial." It gave weight for weight fully 2 per cent. more oil and yielded its oil much more easily, while the cake was far softer and sweeter than that produced from the red seed. In a subsequent letter Colonel Ouseley returns to the subject (p. 249), and shows its relative value in 1835 to 1844 compared with wheat and gram. It then fetched the same price as the best qualities of wheat, and was one rupee more expensive than the red, per maní (about 5 maunds, 16 seers). Colonel Ouseley then concludes as follows: "White linseed is exported towards Bombay, and is to be found at Jubbulpore; but I understand none grows north of Rewah; from inhabitants of Oudh now here, I am informed it is unknown in that territory; it forms an article of trade south of the Nerbudda and is in great demand." Mr. H. Cope of Amritsar wrote in 1858 (see *Jour. Agri.-Hort. Soc., India, X., Proceedings (Old Series), lxxxviii*) of the white seeded flax:—"If I remember right it was you who told me that the Jubbulpore white linseed became brown again on sowing in other parts of India, showing that the white was a more local variety. In order to test the accuracy of what I believed was only a surmise on your part, I obtained a small quantity of mixed white and brown seed, carefully separated the white, sowed it myself, and have to inform you that so many of the flowers, which will of course produce brown seed, are blue, that I have no doubt these, which are white this year, will be blue next, and produce brown seeds, the whole returning to their primitive habit."

DISEASES.
58 416

Diseases of Linseed.

Various reports, here placed under contribution, will be found to allude to the precariousness of this crop. It is liable to injury from severe rain

DISEASES.

Rust.

or excessive drought, but its greatest enemy is a parasitic fungus which causes great havoc, according to some writers often diminishing the crop by 50 per cent. The early literature of this disease is extremely interesting. Much was written of it in 1829 and the few succeeding years, but a gap of half a century has then to be passed over, until in modern official literature its ravages are deplored, but little or no attempt made to investigate its cause, or to discover the means by which to avert the ruin it periodically causes. In 1829, Major Sleeman, Agent in the Nerbudda territories, reported the calamity that had befallen the people in the form of a disease that had attacked the *alsí* crop first, then the wheat. He attributed this to a minute insect which penetrated the stem and absorbed the nourishment of the plant, thus ruining the crop. His report, accompanied with specimens, was submitted to Dr. W. Carey, who affirmed that the injury was really caused by a fungus like the wheat blight of Europe (then attracting attention and supposed to be caused by a fungus that passed from the barberry to the wheat). On obtaining this explanation Major Sleeman wrote: "The whole of the phenomena observed and described by me, seem now as reconcilable with the supposition of the growth of a parasitic plant as with that of an insect; for it is only a fungus instead of an insect feeding upon the sap, and when I discovered that the blight had first made its appearance last year in some fields of *alsí* (linseed), I began to believe, that the insects I had seen might be rather the effect than the cause of the calamity, and collected to feed upon these very minute but destructive mushrooms. I gave orders accordingly that the cultivators should in every village be recommended to watch their fields carefully and remove every blade of wheat or other plant the moment any red spots should be discovered upon it, as the only means in their power to preserve the rest.

"On arrival at my present ground I found that parts of every *alsí* field in the neighbourhood had begun to be affected, and that on some the plants were so lately covered with pale red spots as to appear to have altogether changed colour, as you will perceive by the samples forwarded with enclosed letter; and as the only means we have of preventing the dissemination of this disease over the wheat crops seems to be the removal of the *alsí* immediately, wherever it is discovered to be affected, I have thought it to be my duty to give orders to this effect. But orders would be unavailable, were I not to promise that the cultivators of these *alsí* fields should receive a remission of rent upon the lands from which the crops may be removed, since the blight injures but little the seeds already formed in the *alsí*, and does not appear till some few seeds upon each plant are formed, &c." "I have, therefore, promised that a remission shall be granted for all lands from which the *alsí* shall be removed in pursuance of this order."

Continuing his review of observations extending over two or three seasons, Major Sleeman wrote: "I now find that the *alsí* was last year affected by the disease as generally and still more early than the wheat, and that it commonly is so; and as it may be more subject to it, and is generally sown either among the wheat or around the borders of most wheat fields, it may be, if not altogether the source of the disease, the means of increasing and extending it. And as the cultivators can very easily substitute another crop for it, it may be worth while to consider whether it might not be expedient to prohibit the cultivation of this grain for a year or two." Later on he makes the observation: "At present not a leaf or a stalk of the wheat is affected, though close to patches of *alsí* entirely covered with the disease; no *alsí plant is affected till one or more of the seeds have been fully formed upon it.* The wind has for some days blown from the eastward, and since it began to do so, the blight has appeared" on the wheat.

At the time at which Major Sleeman wrote, the life history of wheat

Linseed. (*G. Watt.*) LINUM usitatissimum.

DISEASES.

Rust.

blight was, even in Europe, a matter of speculation, so that it is not surprising that Major Sleeman made the mistake of supposing that in India it came to wheat from the linseed. We have long since known that this is impossible, and that Government and the people were alike deprived of revenue through the repressive measures against *alsí* briefly indicated by these passages. But so alarming had the blight become, that in March 1830 Mr. Holt Mackenzie addressed a letter to the Honourable Sir Edward Ryan desiring the co-operation of the Agri.-Horticultural Society. Referring to Major Sleeman's reports Mr. H. Mackenzie said:—"They relate to a blight, which appears to have occasioned much individual misery and has caused very large abatements to be necessary in the Government demand. If the Society can help us to remedy so great an evil, it will be entitled to no ordinary acknowledgments." It is not necessary in this place to allude to the famine that followed in 1831-32 through the almost total destruction of the wheat crops, nor to the calamity that overtook the starving population from trying to subsist on the pulse Lathyrus sativus, a grain that paralysed the lower extremities of a large number of the persons who ate it. Suffice it to say that it was then supposed that the blight not only went from the *alsí* to the wheat, but to the pulse named, and caused "the paralytic strokes" from which the people suffered. The reader is referred to Lathyrus sativus for further information on the subject of this remarkable property, and it need only be here added that there is nothing to show that the wheat blight was more connected with Lathyrus sativus than with Linum usitatissimum.

In concluding this brief review of the early controversy regarding *alsí* blight, it may be added that even Major Sleeman seems to have ultimately come to the opinion that it was quite unconnected with the wheat blight. This opinion has been recently confirmed by the investigations of Surgeon-Major Barclay, who has determined the nature of the fungi found on *alsí* and on wheat, and shown that they are of necessity utterly unconnected with each other. He has not, however, been able (from want of opportunity) to trace out their separate life-histories, but has made an important step in that direction by the discovery that in many parts of India the wheat blight is not the common European species (Puccinia graminis) which requires in its first stage to exist on the barberry, but is a species of Puccinia resembling P. rubigo-vera, which, in those countries in which its life-history has been traced (Europe and America), passes to a boraginaceous plant. In India the same life-history seems very improbable, since no borage has been found harbouring an Æcidium. This subject will be again reverted to under Triticum (which the reader should consult), but Dr. Barclay's account of the fungus found on Linum may be here given, since it is not merely of scientific value but is of economic interest also, as it establishes the independence of flax from wheat blight.

"I obtained," says Dr. Barclay, "excellent specimens of a species of Melampsora, gathered on 4th April 1890 at Dumraon (North-West Provinces). The leaves were very extensively attacked with orange red pustules, oval to round, but coalescing freely, and often involving most of the leaf surface. These pustules are mostly epiphyllous, and they are often surrounded by a wall of epidermis, giving them the appearance of the æcidial fructification of Phragmidium. In other parts, dark crests might be seen which were the teleutospore beds."

"The UREDOSPORES are pale orange red, and are accompanied by colourless capitate paraphyses, sometimes of very large size, the head exceeding the spores in diameter. They are round to oval, and the dried spores, when just immersed in water, measured 21—18 × 18—16μ. But after lying 48 hours in water most spores become spherical, measuring 24—21μ in diameter. The epispore is sparsely beset with spines. I could not ascertain

DISEASES. Rust.

the number of germ pores. The paraphyses had heads measuring 30—28×20μ. The TELEUTOSPORES are long, cylindrical, or prismatic, single-celled bodies, very firmly adherent to one another laterally. They each exhibit a central nuclear space, and measured, after lying 48 hours in water, 54—56×10—9μ. They did not germinate after lying some days in water, and I conclude a period of rest is necessary before this can take place. This is no doubt **Melampsora Lini**, *Pers.*" The spore measurements show a slight difference from those given by European authorities, and the Indian form has large-headed paraphyses. These differences, however, are not important.

The above facts regarding Linseed blight have been obligingly furnished by **Surgeon-Major Barclay** from his forthcoming paper in the *Journal of Botany*.

AREA. 418

Area under Linseed in India.

The various reports that exist on this subject admit the impossibility of arriving at definite information regarding the actual area under linseed, owing to the very general habit of raising it as a mixed crop. If intended for local consumption it is frequently grown along with mustard, both seeds being expressed at once, for their mixed oils. For this purpose also, pure linseed is very often mixed with mustard or other oil-seeds at the native oil-mills, and mixed oils of various recognised properties thereby produced. To the people of India the drying property of pure linseed is of no consequence, owing to their having no occasion to require an oil of that nature (see "**Pigments**"). Sometimes, however, linseed is grown with non-oil-yielding crops; for example, it may be seen forming lines through the gram or other pulse fields. The produce is collected separately, such pure seed being mostly intended for the foreign markets. But if grown as a mixed crop the greatest possible difficulty must necessarily be experienced in definitely determining the area under it. In the agricultural reports for 1885-86 and 1886-87 more of the provinces endeavoured to give the areas under linseed than in the succeeding years down to 1890. In Bengal, Mysore and Coorg, Ajmir, and Assam, no attempt has been made, but with the exception of Bengal the amount grown in these provinces is unimportant. It will be found that to produce the quantity shown as yielded by Bengal, the area cannot be on an average far short of 1,500,000 acres. Assuming this to be correct, the following were the areas under the crop during 1885-87:—

Provinces.	1885-86.	1886-87.
	Acres.	Acres.
I.—Bengal	1,500,000*	1,500,000
II.—North-West Provinces and Oudh	466,161†	499,673†
III.—Central Provinces	1,024,414	760,942†
IV.—Berar	621,893	386,374
V.—Bombay and Sind	435,912	411,197
VI.—Panjáb	32,281	24,454
VII.—Madras	30,677	16,558
VIII.—Burma (Lower only)	20,351	23,605
TOTAL	4,131,889	3,622,803

* It seems quite certain the actual area was over, rather than under, this figure since the estimate is framed on the assumption that it was entirely grown as a pure, not as a mixed, crop.

† This does not include mixed crops.

AREA.

In the subsequent reports to those from which the above figures have been compiled, the following provinces have reported their areas:—Bombay, including Sind, 309,786 acres in 1887-88, and 215,450 acres in 1888-89; Central Provinces, 633,928 acres in 1887-88, and 668,047 acres in 1888-89; Berar, 317,018 acres in 1887-88, and 304,620 acres in 1888-89; Panjáb, 36,158 acres in 1887-88, and 37,411 acres in 1888-89; and Madras, 12,985 acres in 1887-88, and 20,887 acres in 1888-89. On the whole the acreage under linseed seems to have remained stationary, the decline shown being in most cases a correction of the error for mixed crops. It seems thus safe to say that the total area in all India fluctuates about 4,000,000 acres, an acreage which, estimated on a mean yield of 2 cwt. to the acre, would at least produce the amount of seed annually shown to be exported. The Indian consumption of linseed is comparatively small, but to be quite safe the maximum area cannot exceed 5,000,000 acres, otherwise a lower average production must be assumed.

CULTIVATION OF LINSEED.

CULTIVATION IN BENGAL. ₹ 419

I.—BENGAL.

Although, as already stated, Bengal is the largest producing area for linseed, nothing can be learned regarding its cultivation. The Gazetteers are silent on the subject, and the Agricultural Department has only once briefly alluded to it. In the Administration Reports the traffic in the seed is sometimes dealt with; in the issue for 1888-89, for example, the following table occurs of the imports into Calcutta:—

		1887-88. Mds.	1888-89. Mds.
1.	Behar	50,82,873	41,99,502
	Bengal	11 48,696	12,19,966
2.	North-West Provinces and Oudh	16,21,659	20,33,292
3.	Assam	47,118	59,079
4.	Central Provinces and Rájputana	81,013	19,755
5.	Other places	8,922	10,694
		79,90,281	75,42,288

Area. ₹ 420

The Bengal area under linseed cannot be learned for certain (nor, indeed, that of any crop), but the above traffic returns afford the means of an approximate estimate. It would seem from the yield per acre, as given by all other provinces, that a minimum of 2 cwt. would be safe, but if this be under or over the mark of acreage production in Bengal, the statement here made could easily be corrected. On the assumption that the quantities, bracketed under No. 1, in the above statement of the Calcutta supply, were produced from a yield of 2 cwt. to the acre, Bengal and Behar must have had 2,225,560 acres in 1887-88, and 1,935,468 acres in 1888-89, under linseed. If the average yield proves by future enquiry to be more than here given, the necessary acreage would of course be lessened, but it seems safe to infer that the average annual acreage in Bengal under this crop cannot be below 1,500,000 acres, and is more probably nearer two million acres. In the passage which here follows it will be seen the Director of Land Records and Agriculture puts the yield at 2 maunds per acre (an estimate very probably considerably lower than the actual yield, for judging from the returns regarding the other provinces of India a yield of 3 cwt. to the acre would appear to be more nearly correct: *conf.* with remarks regarding Bombay), but if he be correct, the mean acreage in 1887-89 must have been 2,912,759 to produce the quantities shown as delivered at Calcutta from Bengal. The Director, in his Annual Report, 1886, fur-

Bengal.

Soil.

421 49

nished the following facts regarding Linseed, and it is to be regretted no other information on this very important crop is available:—

"Linseed is not a crop which is grown throughout the whole division of Burdwan. It is more largely cultivated on the *dearah* lands than anywhere else.

"Soil.—It is grown on all the different classes of soils comprised between the lighter class of clay and sandy loam. Linseed is supposed not to do as well in stiff clay as in light sandy soils. The land must be well drained, stagnant water being most injurious.

"In the cultivation of this crop one or other of the two following methods is adopted, according as it is grown in the interior on clay lands or on the *dearah* lands on the beds and banks of rivers.

"On Clay Lands.—Here the plan adopted for growing linseed is the simplest imaginable. As soon as the paddy field has become sufficiently dry, linseed is broadcasted on the standing paddy at the rate of two seers per bigha. The paddy is harvested as usual, the linseed being left to be reaped in *Chaitra*.

"On the Dearah Lands.—Here linseed is sown either alone or mixed with wheat, gram, mustard, or *kheshári*. Sometimes more than two of these crops are grown together. The land for linseed receives three or four ploughings and two or three harrowings. Linseed should not be buried deep, otherwise the seeds will not germinate properly. The seeds are, therefore, not ploughed in, but simply covered by passing the ladder over the field once or twice.

"When sown with such a crop as gram or wheat the plan adopted is this:—After wheat or gram has been sown, the land is ploughed. Linseed is now broadcasted, and the operation is finished by using the ladder twice.

Time of sowing	Aswin-Kartik=October.
Harvest time	Chaitra=March-April.
Quantity of seed for bigha	Three seers when sown alone, one and a half seers when mixed with other crops.

"The yield is very variable. About two maunds would be considered a good average crop when sown alone. Linseed straw is used as fuel."

Chief Linseed Tracts.

422 44

The principal oil-seed tracts in Bengal are along the banks of the Ganges, especially in Patna and Bhaugulpore Divisions. The damper districts are not well suited, but throughout Behar it is extensively grown. M. Deneef, in his practical information on the best mode of cultivating flax in Bengal (quoted above, p. 16) states that 6 seers per *bígha* is the amount of seed required for linseed. The plant should be pulled up by the root a little before perfect ripeness. In Vol. XII (p. 342) of the *Journals of the Agri.-Horticultural Society of India*, the following facts appear regarding linseed in Shahabad:—

"It is always grown in Shahabad as an auxiliary crop with wheat, *masoor*, barley, and other spring crops; and its bright blue flowers are a pleasing relief to the yellowish brown of the other cereals. I have never known it cultivated alone, so that I have no data as to its probable yield per *bigha* or acre. It would probably not be found to differ much from the Linseed crops of England in that respect were the cultivation equal, by which I mean, were the same labour bestowed upon its cultivation, which, however, is not the case in this district at least. Its favourite soil appears to be black clay (*kurile*), but it is sown largely in other soils, and the only difficulty to its indefinite extension appears to be the want of facilities for carrying the crop to market."

the North-Western Provinces and Oudh. (*G. Watt.*) LINUM usitatissimum.

II.—NORTH-WEST PROVINCES AND OUDH.

CULTIVATION IN N.-W. PROVINCES AND OUDH. 423

Messrs. Duthie & Fuller (*Field and Garden Crops, II., 41*) give the following account of linseed cultivation in these provinces:—

Soil. 424

"*Soils.*—The distribution of linseed cultivation offers an interesting contrast to that of *til*. In both cases Bundelkhand is an important field of production, but for very different reasons. *Til* is grown on the light raviny lands which lie along courses of rivers and drainage lines, while linseed is grown on the heavy black *már* or cotton soil of which the level plains are formed. *Til*, in fact, prefers a light, and linseed a heavy, clay soil, and hence linseed is very largely grown in the eastern rice-growing districts, where *til* cultivation reaches its minimum. Linseed is also grown to a considerable extent in the sub-Himálayan districts. Like *til* it is hardly ever cultivated as a sole crop in the districts of the Ganges-Jumna Doáb, but, unlike *til*, its cultivation in this tract is confined to an occasional bordering to wheat or gram fields, and its production as a subordinate crop in a mixture is quite insignificant.

Area. 425

"*Area.*—Linseed cultivation thus is of insignificant importance in the Meerut Division and still more so in the Agra Division. In the Rohilkhand Division it is returned as occupying between 12,000 and 13,000 acres. In the Jhansi Division, which forms the western and least fertile portion of Bundelkhand, comprising the Hamirpur, Banda, and part of the Allahabad District, its area reaches 49,000 acres, or 4 per cent. of the total area under *rabi* crops. But its cultivation reaches its maximum in the Benares Division. The three districts of Azamgarh, Basti, and Gorakhpur return no less then 122,000 acres under linseed, which amounts to 6 per cent. on their total area cropped in the *rabi* season.

Method. 426

"*Method of Cultivation.*—Its method of cultivation varies very greatly in different localities. In the districts of the Ganges-Jumna Doáb it is as a rule merely sown in a line round the border of a wheat or barley field, or is grown in parallel lines across a field of gram. In Bundelkhand it is grown either alone or mixed in large quantities with gram, and in both cases the ground receives three or four ploughings during the rains preceding. The seed is sown broadcast at the rate of 8 to 12 seers to the acre. In the Benares Division it is largely grown on land which is under water during the rains, and in this case its cultivation is of the roughest possible description, no preparatory ploughings being given, but the seed simply scattered over the ground and ploughed in. It is very commonly grown in this fashion in rice fields, the rice stubble being left standing.

Irrigation. 427

"*Irrigation.*—Linseed is very rarely irrigated when grown by itself, except in the Basti and Gorakhpur Districts, where a quarter of the total linseed area is returned as receiving one or two waterings.

Harvesting. 428

"*Harvesting.*—The plants are cut down when ripe, and the seeds extracted from the capsules by beating.

Yield. 429

"*Average outturn.*—The average produce of linseed in Bundelkhand is from six to eight maunds per acre. In Basti and Gorakhpur it may be put as considerably more than this, ten maunds being probably not an excessive estimate."

It would seem probable that the above is a very high estimate of yield, *accountable for, very probably, by the figures being those of a mixed crop* with mustard. Allahabad, Benares, and Oudh, are the most important producing blocks. The following passages from the settlement reports afford additional information on the subject of linseed:—Of Allahabad it is stated (p. 31) that "In other districts this crop is usually grown mixed with gram, *masúr*, barley, and other *rabi* crops. In Allahabad, however, in the lowlands across the Ganges, and to a very great extent in the *márh* tracts south of the Jumna, linseed is grown alone. In the

Allahabad. 430

CULTIVATION.

N.-W. Provinces and Oudh.

Doáb we have only some 40 acres, while in the trans-Ganges there were 3,000 acres and in the trans-Jumna tract 15,000 acres under linseed. The seed forms the export staple of Khairágarh, and is sent in great quantity down the Ganges to the eastern districts and Calcutta. The crop is a hardy one. It requires very few ploughings and no manure, weeding, or irrigation. From seven to eight seers per acre seed is required, and the produce averages three to four maunds per acre" (*Mr. F. W. Porter, C. S. in the Final Settlement Report of the Allahabad District, North-West Provinces*).

Azamgarh.

"Linseed (*tísí*) is sown alone throughout the field, or in separate rows in fields in which other crops are sown, or mixed with other crops. It is grown chiefly in clay soils, in fields from which an early rice crop has been taken, or like *latri*, in places where no better crop could be sown with as little tillage and without irrigation. For linseed the land gets little ploughings, sometimes none at all, the seed being simply scattered, like *latrí*, over the damp ground. It is also left unirrigated. Not very much linseed is raised in Azamgarh, but more perhaps than the settlement returns indicate. For, in some instances, land which produced both a rice and a linseed crop has been entered under the more important crop—rice. Ten or twelve seers of seed per acre should be sown for a full crop, but in Azamgarh, where little consequence is attached to the crop, so much is not always allowed. Ten maunds is a good return per acre. The plant suffers much from rust (*girwí*) in damp seasons. Linseed yields one fourth of its weight in oil. The oil-cake is given to cattle, but is also consumed by human beings, either mixed with *gúr* or alone. When eaten by human beings it is dignified with the name of *Pinné*. Linseed is also eaten by the people, being first pounded in an *okharí*, and then baked in dough" (*Mr. G. R. Reid, C.S., in the Settlement Report of the Azamgarh District*)

Banda.

"*Alsí* is, like *kodon*, not unknown elsewhere; but in this district (Banda) it is grown in a considerable area and linseed constitutes an important article of commerce. In this, as in other districts, *alsí* is frequently sown with other crops, but even alone it occupied at settlement nearly 2 per cent. of the cultivated area, nearly half of this being in the Banda tahsil. Some of this preponderance is no doubt due to the extent of *alsí* entered as mixed with gram in other pergunnahs, but the impression left on my recollection is that there is more and finer *alsí* in Banda than in other pergunnahs. If only a third area of the mixed crops of gram and *alsí* be assumed to be *alsí*, the crop covers over 16,000 acres, or 6 per cent of the area under cold weather crops" (*Mr. A. Cadell, C.S., in the Settlement Report for the Banda District, North-West Provinces*).

IN THE CENTRAL PROVINCES.

III.—CENTRAL PROVINCES.

Area.

In the report of the crop for 1888-89 it is shown that the provinces had 612,022 acres under Linseed. The principal districts are Wardha (118,036 acres), Nagpúr (104,789), Raipur (101,020), followed by Jubbulpore, Chanda, and Saugor, each with less than 100,000 acres. In the Agricultural and Revenue Reports for 1884-85 it is stated that linseed attains its greatest importance in Wardha and Chanda, where it covers 21 and 18 per cent. of the area under crop. In Nagpúr the percentage is 16, in Raipúr 11, and in Damoh 10. In every district it is grown more or less, and in some of the reports is said to be even meeting with greater favour than wheat. The total area under the crop has, however, contracted somewhat in recent years. The Director of Land Records and Agriculture reports that as it is sown later than wheat, it suffers less from failure of the October rain.

CULTIVATION. Central Provinces.

"The arch enemy," he adds, "of linseed is rust, and during this season it has, at all events, escaped damage from this source. Where a crop has germinated, the outturn will be fair. But over a considerable area germination has failed altogether, and the outturn will certainly fall very short of being satisfactory." In a forecast of the crop for 1885, the Director of Land Records and Agriculture wrote: "It is reported from two districts that there is a decrease in area owing to the ground having become too hard for sowing, but this is a great deal more than counterbalanced by a very general increase, resulting from linseed having encroached on land ordinarily sown with wheat and also from its having been sown on land which bore *kharif* crops, during the preceding monsoon months, but which, owing to the excessive rain, failed to give produce. There is also a steady annual increase in the area under linseed, owing to the active demand for it. The export of linseed is, next to that of wheat, the most important feature in the export traffic of these Provinces, and cultivation is steadily responding to the demand of the Bombay market. The increase in linseed cultivation is especially marked in districts such as Nagpúr, in which much of the soil is not of sufficient depth for the produce of wheat, and where the growth of linseed is increasing at the expense of the cotton and millet crops. It does not seem extravagant to assume an increase of at least 10 per cent. in the linseed area of the current year.

"The prospects of the standing crop are satisfactory: rain was much wanted for it a month ago, and in some places the plants were beginning to wither. But rain has now very generally fallen and the crop has immensely benefited. A little harm has resulted in the Raipúr district from the ten days of cloudy weather at the end of December, which have been prejudicial to the proper fertilisation of the flowers, but after making allowance for this a full crop may be expected in Raipúr as well as in Biláspur, and the reports from other districts show that prospects are very nearly, if not quite, up to the average throughout the provinces."

Yield.

The following passages from the Nagpur Experimental Farm Reports afford additional information, especially as to yield of seed *per* acre:—"As in the case of wheat, two varieties were grown, one being the brown (or *katha*), and the other the white grained (or *haura*) kind. There was nothing experimental about the cultivation, which was conducted on precisely the same system as that followed by native cultivators. The land was prepared by frequent *bakharings* or bullock harrowings during the rains, and the seed was sown in October with the triple bamboo drill (or *tifan*). No manure or irrigation was used. The total area under linseed was 7·89 acres, comprising five fields which yielded a maximum outturn of 638 lb, a minimum of 294lb, and an average of 428lb to the acre. I have not, however, included in this a patch of remaining land on which linseed was sown as a speculation, but which produced only 96lb to the acre. The white and red varieties were sown in two adjoining fields, the areas of which were respectively 1·46 and 1·05 acre. The white variety gave the largest return, 638lb to the acre against 590lb. But this fact affords of course no safe basis for generalisation as to the relative productiveness of the two varieties. Both may be valued at the same figure, R16-4-0 per *khandi* of 382·5lb" (*1883-84, p. 7*). "Linseed was grown on 14·81 acres, the seed used being of the white or *haura* variety. The average outturn per acre was 215lb. The average outturn of last year was nearly double this, but was obtained on a much smaller area. The linseed crop was, however, much damaged this year throughout the country by the cloudy weather of December and January, which prevented the seed from setting properly, an injury to which linseed is very liable. Were it not indeed a rather precarious crop its cultivation would increase far more rapidly than it does, since

CULTIVATION. Central Provinces.

weight for weight it is twice as valuable as wheat, and will grow well on inferior classes of soil" (*1884-85 p. 6*).

The writer having failed to discover any detailed statement of the area under this crop, of the seasons and methods of sowing and of reaping, &c., &c., has republished the above passages from the forecasts and farm reports, since these deal with some of the results, and the difficulties and dangers of linseed cultivation. This confession of want of definite information has to be made in connection with almost every province in India, for, although the trade in linseed has steadily progressed, it has attracted only a fractional interest to that of wheat, although the latter crop is practically of only slightly greater value to India.

IN BERAR. 436 53

IV.—BERAR.

In the Administration Report for 1883-84 (*p. 31*) of the Hyderabad Assigned Districts it is stated that the crop was much injured by excessive rain, that the area of cultivation declined by 83,000 acres, while at the same time the exports fell off considerably. The report continues :—

"The exports of linseed are almost exclusively of home produce: very little is imported. The exports and imports of linseed for the last five years have been as follows :—

Year.	Exports.	Imports.
	Mds.	Mds.
1879-80	1,13,000	3,700
1880-81	4,03,000	9,600
1881-82	5,89,000	19,000
1882-83	10,95,000	38,000
1883-84	8,20,000	60,000

"The growth of the trade during this period is almost as remarkable as that of wheat; and it is of more importance as being less dependent on imports from outside and consequently more stable in character, besides being the more valuable crop."

IN BOMBAY & SIND. 437 59 Districts. 138 69

V.—BOMBAY AND SIND.

The chief districts in the Western Presidency that produce linseed are Poona and Sholapur; Khandesh, Násik, and Ahmednagar; Gujarat and Kathiawar; and smaller quantities south of the Nerbudda and below the Ghâts. In the railway-borne trade report for 1883-84 it is stated that, as in the case of food-grains, the supply of linseed from external blocks is derived from the Central Provinces, holding the first rank, Berar next, with Hyderabad and Rájputána following as less important.

The following passages from the Gazetteers convey an idea of the methods of cultivation and other peculiarities in the Western Presidency. *Khandesh* (*Vol. XII., 152*).—"The average acre yield is from 250 to 280lb The cultivation is steadily spreading, owing to the Bombay demand. It forms one of the principal and most valuable exports. Deep loamy soils seem particularly well suited to the growth of the plant. The seed is bought wholesale by wealthy merchants from the cultivators." "The plant is too short and branchy to yield fibre of any value It is never prepared, and many husbandmen are ignorant of the fact that the plant yields fibre. As nearly the whole of the seed is exported, little oil is pressed in the district." Of *Násik* (*Vol. XVI., 100*) it is simply stated to be sown in October and reaped in January. Of *Ahmadnagar* (*Vol. XVII., 270*) it is stated—"Sown in rich black soils, often with gram or wheat, in separate furrows or by itself as a separate crop, and, without water or manure, is harvested in February.

CULTIVATION. Bombay & Sind.

The seed is eaten in relishes or *chatnis*, and the oil, which is produced in the proportion of one pound of oil to four pounds of seed, is used in cookery. The fibre of the plant is not used." In *Sátára* (*Vol. XIX., 164*) it is said to be sown in November and harvested in February. In *Dharwar* (*XXII., 273*) it is known as *agashi* (KAN.) and *javas* (MAR.): in *Bijapur* (*XXIII., 319*) it is *alshi* (KAN.) and *javas* (MAR.). In *Kolhapur* (*Vol. XXIV., 171*) it grows with cotton, late *jowári*, and wheat. It is harvested in about three and a half months. Pure linseed oil is expressed for painting purposes only. Most of the linseed grown in the State is sent to Bombay. Its average outturn is 375lb."

The following passages from the Experimental Farm Reports and the Special Reports of Crop Experiments to ascertain the Yield per Acre, may be here given:—

Method and Yield. GP 439

"The last crop selected for special enquiry was linseed. It is in this country grown as an oil-seed and never for flax. It is a most delicate crop, suffering from various diseases, of which a fungoid disease, probably rust, is the most common. Even where the attack is slight and in appearance the crop has not suffered, it is found that the capsules are only partly filled and the yield is thus often reduced by half without apparent injury. It is sown alone in Khándesh, but in the Deccan and Southern Marátha Country, chiefly as a row crop with wheat or gram and round the headlands. The framers of the formulæ credit the crop with a maximum yield of 500lb in every táluka in which it is grown. In Khándesh it is sometimes taken as a late crop following *bájri* of the same season. Linseed has seldom been selected by experimenters, and little is therefore on record as to its varying yield. In the season under report it was almost a complete failure in the Deccan and Southern Marátha Country from prevalence of the fungoid disease noticed above. An experiment was made in Dhárwár by Mr. H. R. Shirhatti which gave a yield on very poor soil (assessed at 14 annas 9 pies per acre, full of limestone nodules and very shallow) of 33lb per acre. It was here grown as a row crop. *Jowári* was sown with the 4-coulter drill and on every fourth row alternately, gram and linseed were deposited on the sown *jowári* by the seed tube. The yield of 33lb on every eighth row represents a yield of 9×33=297lb on the acre of linseed. It will be interesting if this crop could be selected specially again this year, care being taken to note whether (1) it is the sole crop of the year, or (2) the second crop after an early crop, or (3) a row crop. In the last case the number of rows of linseed and of the principal crop shown with it should be noticed" (*Crop Experiments, Bombay, 1885-86, p. 8*).

"Since the receipt of instructions of the Government of India to prepare forecasts of oil-seed along with those of wheat and cotton, this crop has attracted my particular notice, as it is grown in this presidency as an oil-seed and not for flax. This was consequently one of the crops selected last year for special enquiry, but only one experiment was made on it on a poor soil. So it was then desired that this crop should again be specially selected for experiment this year wherever available. Linseed is reported to have been grown in Násik this year to such an extent as to affect sensibly the area under wheat. In the field experimented on, linseed mixed with a little mustard was the sole crop of the year, and though the year's crop as a rule suffered from the fungoid disease, the plot under experiment escaped, and the yield (estimated at 14 annas) was 225lb of linseed with 4¾lb of mustard. The corresponding formulæ yield us 450lb of linseed. The formulæ estimate at indiscriminately 500lb the acre in every táluka without considering the soil and climate, &c., as was the case found in Dhárwár last year, appears rather high" (*Crop Experiments, Bombay, 1886-87, p. 7*).

LINUM usitatissimum. Linseed Cultivation.

CULTIVATION. Bombay & Sind.

As the result of the crop experiments perfo[illegible] Khándesh with linseed it was found, that while the yield wo[illegible] by the formula should have been 239lb to the acre, the actual produ[illegible] 308lb. In another experiment the yield was 322lb. Mr. Whitco[illegible] states that 360lb would be a good estimate for an 11-anna crop.

IN THE PANJAB.

VI.—PANJAB.

Some twenty years ago Mr. Baden Po[illegible] wrote of the Panjáb that linseed was extensively cultivated on account of its oil-yielding seed. "In Kangra it is thrown in among the stubble after cutting the rice crop, and then springs up witnout any cultivation." In many of the settlement reports of the province mention is made of linseed. Thus in the Lahore report it is shown as sown in October and reaped in March, the land twice ploughed and five times watered with a yield of 20 seers per *kanál*. The total area under the crop is perhaps under 30,000 acres and the exports very insignificant.

The following passage regarding linseed cultivation in Kashghar may be here given:—"Extensively cultivated for its seed in all the western divisions. The seed is the chief source of the oil used in the country, and the cake is given to the stall-fed cattle. The oil-mill or press is worked by horses or oxen, and is similar to that used in the Panjáb. The seed is sown in April and May, and the crop is cut in October" (*Report of a Mission to Yarkand in 1873, 78*).

IN MADRAS & BURMA.

VII. & VIII.—MADRAS AND BURMA.

The amount of linseed grown in these provinces is too unimportant to necessitate separate notices in this work. The reports of the Saidapet farm should be consulted regarding the experiments that have been tried.

PRICES.

PRICES OF LINSEED IN INDIA.

In the *Transactions of the Agri.-Horticultural Society of India* (*Vol. VIII., pp. 146-204*), a paper is given which deals with the market prices of staple articles of Indian trade in various districts during 1839. It is explained that the value of the rupee had been taken as 2 shillings and the seer as 2lb 0 oz. 14 dr., avoirdupois. The prices are expressed at so many seers to the rupee, but reducing these to rupees per maund, so as to allow of comparison with more recent returns, the following may be given—

Localities.	Price per maund in the chief Marts during 1839.		Price per maund in a small neighbouring Village during 1839.	
	May.	December.	May.	December.
	₹	₹	₹	₹
Delhi	3	3	3-5	2-15
Benares	1-3 to 1-4	1-5 to 1-7	1-2-0	1-7-0
Dacca	1-5-0	1-2-0	1-1-0	1-1-0
Calcutta	1-4 to 1-7-0	...	...	...

The Department of Finance and Commerce annually publish a return of Prices and Wages in India: in that publication the wholesale rate of linseed in Calcutta is given since 1843. It would perhaps serve no good purpose to enumerate the prices in all these years, but the following may

PRICES.

be quoted :—January 1843, R2-5-0 a maund ; July 1844, R1-15-0 ; January 1847, R2-3-0; July 1848, R2-3-0. Ten years later January 1857, R4-2-0 and July 1848, R4-2-0 ; January 1867, R4-12 ; July 1868, R4-10-0.

The following statement exhibits the prices during recent years from 1876 :—

PRICES DURING THE MONTH OF JANUARY.				
	Cwts.		Maunds.	
	In Calcutta.	In Bombay.	In Calcutta.	In Bombay.
	R a. p.	*R a. p.*	*R a. p.*	*R a. p.*
1876.	5 7 5	5 9 6	4 0 0	4 1 6
1877.	6 3 8	6 3 0	4 9 0	4 10 8
1878.	6 7 9	6 8 0	4 12 0	4 12 1
1879.	Not shown	6 2 0	Not shown	4 7 9
1880.	Do.	7 2 0	Do.	5 3 2
1881.	Do.	6 8 0	Do.	4 12 1
1882.	5 8 9	6 4 0	4 1 0	4 9 2
1883.	5 3 4	5 3 0	3 13 0	3 12 9
1884.	5 14 3	5 11 0	4 5 0	4 2 7
1885.	5 15 7	5 15 0	4 6 0	4 5 6
1886.	6 2 4	5 15 0	4 8 0	4 5 6
1887.	6 2 4	5 15 0	4 8 0	4 5 6
1888.	5 12 11	Not shown	4 4 0	Not shown.
1889.	6 13 3	Do.	5 0 0	Do.
1890.	6 10 6	Do.	4 14 0	Do.

But perhaps a still more instructive table, obtained from the Reports of the Bengal Chamber of Commerce, would be the following :—

LINUM usitatissimum.

Prices of Linseed.

PRICES.

Linseed.		1873.				1878.				1883.				1888.			
		May.	June.	July.	August.	May.	June.	July.	August.	May.	June.	July.	August.	May.	June.	July.	August.
Exchange	D/Payment 6 M/S	1 11 1/16	1 11	1 10 7/8	1 10 9/16	1 9	1 8 11/16	1 8 1/2	1 8 9/16	1 7 7/8	1 7 7/8	1 8	1 8 1/16	1 4 1/2	1 4 31/32	1 4 31/32	1 4 7/16
	D/Payment 3 M/S	1 10 3/4	1 10 11/16	1 10 1/2	1 10 3/4	1 8 13/16	1 8 7/8	1 8 7/16	1 8 7/16	1 7 3/4	1 7 3/8	1 7 3/8	1 7 31/32	1 4 9/32	1 4 1/4	1 4 11/32	1 4 5/16
Price	England, per 480lb. S.	65-66	64-65	64-65	61-9-61	52-53	52-53	52-53	52-53	43-43-6	41	41-6	44-44-6	36-6	35-9	36-3	37-6
	Calcutta, per B. Md, R	4-10-6	4-10-0	4-11-0	4-8-6	4-8-6	4-11-0	4-14-0	4-15-0	3-11 6	3-12-0	3-14-0	3-15-0	4-1-0	4-3-6	4-5-0	4-5 0
Freight	p. 100 Mds. Rail, Cawnpore, Calcutta, R	75	75	75	75	67	67	67	67	60	60	60	51	53	53	53	53
	p. Ton, Steamer, Calcutta, London £	3-5-0	3-7-6	3-5-0	3-17-6	1-10-0	1-10-0	1-7-6	1-7-6	2-3-6	2-0-0	2-0-0	2-0-0	1-12-6	1-6-3	1-8-9	1-13-9
Shipping Charges p. Ton, Calcutta		Average One Rupee per Ton.				Average One Rupee per Ton.				Average One Rupee per Ton.				Average annas 12 per Ton.			
Exports	Bengal . Cwt.	21,51,475				51,99,353				34,92,945				59,00,045			
	Bombay . "	81,8 0				19,99,385				34 44,000				25,21,814			
	Sind . "	.....				... ...				18				814			
	Madras, &c, "	1,084				180				151				.....			
	TOTAL "	22,37,439				71,98,918				67,37,114				84,22,703			

PRICES.

The table on the page opposite shows the position of the Calcutta Linseed Trade during each fifth year since 1873, *viz.*, rate of exchange; price in Calcutta and in England; railway freight from Cawnpore to Calcutta; steamer from Calcutta to London; and shipping charges. It concludes by exhibiting the actual amount of linseed exported from each of the four principal ports. It will be seen that during these fifteen years exchange fell from 1*s.* $11\frac{1}{16}$*d.* to 1*s.* $4\frac{7}{16}$*d.* on bills at six months. Coincident with that depreciation in the value of silver, the English price of linseed declined from 66*s.* to 37*s.* 6*d.* per 410lb, but the Indian value fluctuated above and below an average of R4-5-8, reaching its maximum in 1879 at R5-2 and its minimum in 1876 at R3-9. Thus it may practically be said that the actual value of Indian linseed was attained about the time of the annexation in 1857, and that it has maintained an average price ever since, namely, R4-5-6 per maund. The most serious reductions that have taken place have been in the railway and marine freights and in the shipping charges. Taking Cawnpore as an example, and it is one of the most distant important centres of supply, the railway freight was reduced, during the past fifteen years, from R75 to R53 per 100 maunds, and the freight to England from £3-5-0 to £1-13-9.

LINSEED OIL.

OIL.

Percentage of Oil obtained.

Yield from seed.

In an official correspondence regarding the desirability of opening out Linseed Oil Mills in India, Mr. Luchman Parshad Barmah, Superintendent, Cawnpore Experimental Farm, gave the following particulars regarding the yield of oil:—"The amount of oil from a given weight of linseed, varies with the different varieties and also with the age of the seed. Fresh linseed, pressed just after it is gathered from the field, will give a larger quantity of oil than the same weight of old seed. *Bold* seed gives higher percentage of oil than *small* variety; and a white variety of Jalaun gives higher percentage than either of these. In the experiments tried last year at the Cawnpore Experimental Farm the following percentages were arrived at with the different varieties. The oil was pressed in a country *kolhu* and just after the harvesting of the seed:—

	*Percentage of oil to seed.	* Percentage of cake to seed.	Loss.
White seed	35·1	54·2	10·7
Bold red	31·2	64·8	4·0
Small	29·6	67·1	3·3

"In a letter to Mr. (now Sir E.) Buck, dated February 27th, 1880, Sir James Caird, of London, gave 130lb as the weight of oil in 410lb of seed, which amounts to 31·7 per cent. on the weight of seed pressed.

"The information collected from *télís*—men who have made oil-pressing their profession—gives the quantity of oil from 25 to 30 per cent. of the weight of seed pressed. I think we may fairly expect 30 per cent. of oil if good seed is employed."

In conversation with the Superintendent of a large Indian oil mill the writer learned that 30 per cent. would be an exceptionally low average yield of oil from good linseed. But it seems probable that with native

* The seed was weighed after it was thoroughly cleaned and was going to be pressed: oil and cake weighed a week after pressing when the dirt present in the oil had settled and the cake had lost its moisture.

OIL. Yield from seed.

appliances even less than 30 per cent. is obtained. The following passage alludes to native methods of extraction of the oil :—

"It is grown in South Shahabad principally for home consumption, and is used largely for lamps under the name of *Tease-ka-tél*. Under the native process, which is the same as previously described, it produces 15 per cent. of oil;—what it produces with the European method I am unable to say. The native method produces a tolerably clear-looking oil, but it smokes much in burning, showing that a large proportion of vegetable fibre finds its way through the rude press into the pure oil: considerable quantities are grown near the Ganges for export. The price varies much according to the season and the quantity in the market. I have known it sell for ₹40 or £4 sterling per ton, and I have known it fetch double the price" (*Jour. Agri.-Hort. Soc. India, Old Series, Vol. XII., 342*).

Quality. 444 66

Quality of Indian Linseed Oil.

In 1855 the late Dr. F. Royle wrote on this subject :—"It may appear remarkable that Linseed oil should be imported into Calcutta, when so much linseed is exported for the express purpose of yielding its oil. This is in consequence of the linseed oil of India being considered as not possessed of the full drying properties of the oil prepared in Europe. But there is no doubt, this is owing entirely to the Indian Linseed being expressed before the mustard seed has been separated with which it is commonly mixed, in consequence of the two plants being often grown together. Mr. Bowen informed the author that, when connected with one of the light-houses in India, he had at one time under his charge some plate glass. This he made use of to separate the two seeds, by placing it on a slope: the round seeds of the Mustard rolled off, while the Linseed merely slipped down. These, when expressed, yielded as good drying oil as any he ever obtained from Europe. The same fact is confirmed by the following statements.

"In a report from Mr. W. Ewin, Branch Pilot, to Captain W. Hope, Master-Attendant at Calcutta, he acknowledges the receipt of five gallons of linseed oil, made at the Gloucester Mills, situated below Calcutta :—

"'I beg leave to say I painted my boat inside green with the above oil, without the assistance of turpentine, and it dried within the space of twenty, four hours. I do not hesitate to say therefore if the above oil, agreeable to the muster, be given, that it is equal to the linseed oil received from the Honourable Company's Marine Yard, said to be from Europe. Sandheads, H.C.P.V. *Sea Horse*, 2nd January 1837.'

"So Mr. W. Clark, commanding H.C.P.S.V. *Hope*, writes, 14th December 1836 :—'I have to report, for the information of the Master-Attendant, in reply to his letter (No. 39) of the 7th ultimo, that I have painted the *Hope*, outside, with the Gloucester Mill oil on one side, and that supplied by the Naval Store-keeper on the other,—both laid on at the same time; and of the two I must give the preference to the former, in drying and bearing a better gloss.'"

Since the above was written the subject appears to have been spasmodically discussed, Indian writers maintaining that if carefully prepared (after having been freed from the rape seed with which it is purposely or accidentally mixed), the Indian linseed affords an oil by no means inferior to that obtained from European seed, while European reports, mostly, it is contended, from interested parties, affirm that it is considerably inferior. It will be seen from the remarks below that meanwhile the foreign exports of linseed have increased to a far greater extent than have those of almost any other single article of Indian agricultural production, so that there can be no doubt the oil has come into extensive use in Europe. It

OIL.

Quality.

is thus somewhat surprising that Indian capital should have, up to date, been almost entirely diverted to other channels instead of a fair proportion being devoted to a competition with European oil mills in the production of linseed oil. By this means unnecessarily heavy freight charges have had to be paid on one of India's most important crops, the cake and manure, which should have been left in the country, have enriched the cattle and fields of other parts of the world, leaving India to have a relatively smaller net gain in the linseed transactions than might be supposed from the magnitude of the figures of foreign export.

Samples of Linseed oil were sent (in 1887) from Madras to Her Majesty's Secretary of State for valuation. The reports of the brokers were not very favourable. The oil was pronounced "far below what it should be if proper appliances are used for crushing the seed." "The oil appears to have been expressed from Linseed which has been mixed with other sorts of seeds." "The result of this admixture is an unusual taste and odour." "The oil is deficient in the drying properties which characterise oil expressed from pure linseed." "The oil would be saleable here at about £1 per ton below the market price of merchantable linseed oil which to-day (21st April 1887) is quoted at £20-10 per ton." Similar opinions were expressed by the other brokers who examined the Madras samples. These opinions were duly published in India and called forth a protest from a well-known Calcutta firm, who maintained that opinions upon ordinary native-made linseed were likely to damage the trade in the pure article (such as that prepared by the Gourepore Company, Limited), since the oil expressed from Linseed and Mustard mixed, the ordinary native method, was certain to possess a much lower drying property than pure European linseed, or, indeed, than Indian linseed. In support of this statement the late Dr. Waldie's report on Gourepore Linseed oil was submitted for the information of Government. Dr. Waldie was, for the purpose of analysis, furnished with two samples of oil, one of the Gourepore ordinary trade oil, the other, English Linseed oil furnished for the purpose of comparison. Dr. Waldie wrote that the colour of the English oil was a little darker than the Gourepore; that the smell of both was nearly alike even when heated, neither oils giving evidence of the presence of any substance other than linseed. The specific gravity of the Indian oil at 60°Fh. was found to be 933 compared with water as 1,000, the English 934. The solubility of both oils in alcohol was practically the same (1·28 per cent Indian and 1·63 per cent. English). Dr. Waldie then tested the oils for purity and found the Indian to vary from the English no more than is known to be the case between most of the qualities met with in Europe (Russian, Dutch, English, &c.). With regard to their drying property Dr. Waldie wrote: "Both oils spread thin on small porcelain basins and exposed to a moderate or gentle heat, dried in about the same time, and the dried oils appeared equally firm." The English was browner in colour; but "there is no apparent difference by this experiment between the two in drying properties."

It would thus seem that either the Madras oils reported on by the London brokers was prepared indifferently, the seed not having been freed from the frequent adulterant—mustard seed—or that Madras Linseed yields a much inferior drying oil to that obtained from other parts of India. Mirzapore seed is reported to yield more oil and of a better quality than that of the Eastern Districts of Bengal. It would thus appear highly probable that not only is white linseed quite different from the red, but that the red seed of certain tracts of India affords better oil than that from other parts of the country. It would thus seem desirable, as one of the first steps towards the establishment of extensive oil mills in India, to have the exact properties of the oil of the various races of seed separately

OIL.

Price.

445 67

Mills.

446 68

and carefully prepared and tested. From the numerous reports that have appeared it would seem that the white linseed may expand into a trade of considerable magnitude, and that too even should it prove of less value as a drying oil.

Price of Linseed Oil and Linseed Cake.

The best oil sells (wholesale) in India from R1-8-0 to R1-12-0 per gallon for raw oil, and at R1-10-0 to R2 per gallon for boiled oil. The oil-cake is shipped to England for sale and is said to realise from £6 to £7 per ton.

For further particulars regarding the properties and uses of Linseed-cake see the Article OILS.

INDIAN LINSEED OIL MILLS.

The following passages from Mr. L. P. Barmah's report may be here given. He describes three methods of (and the machinery used in) expression of the oil :—

"(*a*) *Kolhu.*—This consists principally of a thick block of wood with a cavity in the centre, which receives the seeds, and a moveable rod which, with a few minor arrangements, is made to revolve in the cavity of the former piece and thus press against the seed; the oil which is thus expressed runs out through a spout. The cost of a medium-sized press of this description is about R6, and the bullock required to work it can be had for R10 or R12. It presses 7 seers linseed a day, working eight hours, or nearly 5 maunds a month. It is attended to by women, on whom it devolves as one of their household duties; but if worked by hired labour, a man on 2 annas per diem would be required for every three presses, which amounts to R1-4 per month per press; the man would look after the bullocks too. Taking all the year round, the cost of feeding a press bullock amounts to Ro-1-3* per day, or R2-5-6 per month.

"The wear and tear of the press amounts to 5 annas per month. To these we may add interest at 6 per cent. on the capital invested in the manufacture of the *kolhu* and purchase of bullocks, amounting to a monthly expense of Ro-1-4 nearly. Thus the total cost of working a *kolhu* per month, during which it will press 5 maunds seed, is R3-15-10 :—

	R	a.	p.
Labour	1	4	0
Feed of bullocks	2	5	6
Wear and tear of the press	0	5	0
Interest on capital	0	1	4
	3	15	10

"Therefore, the cost of pressing 100 maunds seed by a native press amounts to R79-12-8."

"(*b*) *English Hand Press.*—This was once used by a firm in Cawnpore, but finding it difficult to dispose of the cake and oil, the attempt was abandoned. The press consisted of two strong screws and a number of iron plates. The seed was ground by an English grinding mill, placed in a piece of gunny cloth and then put in between each pair of plates; when all the plates were thus occupied, a fire was created by burning coal on the two sides and the screws tightened. The pressure assisted by heat expressed the oil, which ran down a channel into a reservoir where it collected. About 1¼ maund of linseed was thus pressed at a time, each pressing taking an hour and a half and done by four coolies, who received Ro-2-6 for every pressing; two of them worked the press and the other two covered the seed in gunny cloth and took rest. About 10 maunds of seed was thus pressed

* Fodder and Cake.

OIL. Mills.

per day of 12 hours by one of these presses. The cost of pressing 10 maunds of seed by each press may therefore be taken at R4-9 :—

	R	a.	p.
Labour employed, in grinding at 2 pice per maund of seed	0	5	0
Ditto in pressing, at 2½ annas per 1¼ maund	1	4	0
Coal worth 4 annas for every pressing	2	0	0
Gunny cloth renewed after every 10 or 12 pressings	1	0	0
Total	4	9	0

"From the reservoir the oil was carried to the boiling-pan, where water was added to it in the proportion of 1 to 40, boiled for about an hour and a half, and then removed to a strainer. When the oil sufficiently cooled down it was put in canisters. About 32 maunds of oil could thus be boiled in a day."

(c) *English Steam Press.*—Mr. L. P. Barmah gives particulars of an English steam press that was formerly established by Guru Prasad, a merchant in Cawnpore. About 100 maunds of seed could be pressed a day at a cost of R18-4-5, but wood, instead of coal, was employed, the cost of manufacture being (as afterwards shown in the correspondence on the subject) unnecessarily high.

Mr. J. E. O'Conor, in the Statistical Tables for British India, shows that there were in 1889-90 some seventy oil-mills and oil-wells in India. He does not mention, however, the Gourepore Company, Limited, the only Indian mill that is believed to be exclusively devoted to Linseed. The writer understands that the Gourepore Company produce about 700 gallons of very superior oil daily, which enters into competition with imported oil, and finds a ready and profitable sale. In the official correspondence, towards which Mr. Lachman Parshad Barmah contributed the report laid under frequent contribution here, it was contended that oil-mills should, if possible, be in the future established near the seaport towns. That the railway charges in India were more favourable to the carriage of seed than oil, hence the advantage of expressing the oil at the end instead of on the line of railway transport. The discussion that ensued seemed to proceed from the basis that the object in view should be the export of oil instead of oil-seed, thus leaving as much of the cake as possible in this country, to improve the cattle and soil of the regions on which so exhausting a crop as linseed was systematically grown. The opponents of this idea of coastwise mills held that if once the seed was removed from the actual district of production, the cake would never find a market in India, as the cultivators could not afford to pay railway freight on its return. The oil hitherto produced in India has, however, found its best market in India itself, the cake alone being exported. It would thus appear that when (if ever) extensive oil-mills, for the purpose of exporting oil to the American, Australian, and European markets, are established in India, the cake also will have to be exported, so that, except in the sense of opening out a new industry, a new field of labour and of investment of Indian capital, this country will not benefit any more than it is now doing by the large market that it has established for its linseed. There would seem no good reason, however, why India should import any linseed oil. Mills should exist sufficient at least to meet the entire Indian market for the oil, for even if slightly inferior as a drying oil, this should be more than compensated for by a saving in price equivalent to the freight to Europe of the seed and the return charges in bringing the oil to the shores of India. Many years will doubtless pass by before the Indian cultivators will realise that it is in their best interests to keep a large proportion of the cake to feed their own cattle and manure the flax fields.

TRADE.

Foreign.

447 ☞

INDIAN TRADE IN LINSEED.

Dr. Royle, some thirty years ago, wrote: "The large exports of Linseed from India have frequently been mentioned. It is desirable, therefore, to give some of the details. By these we may observe, that *though comparatively a recent trade*, the article is already known to other countries besides England. The first exports of Linseed were made from Calcutta by Mr. Hodgkinson and were—

In the year	1832,	to the extent of	10 bushels.
,,	1833	,,	2,163 maunds.
,,	1834	,,	2,826 ,,
,,	1837*	,,	32,327 ,,
,,	1839	,,	1,67,601 ,,
,,	1850	,,	7,65,496 ,,

It has already been stated that no mention occurs in **Milburn's** *Oriental Commerce* of linseed, a fact that confirms **Royle's** statement that the article began to be exported from India only about 1832. In the year 1850-51, while Calcutta exported 765,496 maunds, valued at R15,30,902, Madras exported 801 cwt., valued at R2,271, and Bombay, 50,112 cwt., valued at R1,70,539. But in the following year Bombay is shown to have exported 114,309 cwt., and according to **McCulloch's** *Commercial Dictionary*, Great Britain imported from all sources, during 1851, 630,471 cwt. of linseed, of which Russia furnished 417,950 cwt., the "British Territories in the East Indies" standing next in importance, *viz.*, 93,814 cwt.

In the Annual Statement of the Trade and Navigation of British India with Foreign Countries for the year 1866-67, the value of the exports is shown to have been (for that year) R75,04,615. Along with gingelly, rape, and other oil-seeds, linseed was then subject to an export duty, and the amount of revenue thus realised on oil-seeds is shown to have been R5,57,808. Ten years later (1876-77), the exports of linseed amounted to 5,614,617 cwt., valued at R3,01,54,374, the duty having been some years before removed. In 1886-87 the exports amounted to 8,656,933 cwt., valued at R5,17,92,914; last year they were 8,461,374 cwt., valued at R5,05,79,221. Comparing the averages for the quinquennial periods from 1873-74 to the present date, it will be found that the trade shows an increase of 224 per cent. in weight and 278 per cent. in value. But these figures exhibit the foreign exports only, though it may be said they very nearly convey an idea of the total value of the Indian transactions in linseed. They show, at all events, that the trade has expanded from about 3 cwt. in 1832 to 8,461,374 cwt. in 1888-89. We may assume (for the purpose of demonstrating the full meaning of this expansion) that the Indian local demand has remained stationary during these years. To produce the extra amount demanded last year over that in 1832, the total area of linseed cultivation in India must, at the lowest estimate, have increased by 4,230,682 acres.†

Trans-frontier.

448 ☞

If now we turn to the land or trans-frontier imports and exports, we find that, for the past three years, Nepál has exported to India (Bengal) on an average some 175,000 cwt. of linseed, valued at R89,20,000. The trans-frontier exports from India are unimportant, the major portion going to Kashmír.

* In the *Agri.-Horti. Soc. Jour.* for 1842, it is stated the exports from India in 1835-36 were, according to Mr. Bell of the Calcutta Custom House, 1,63,199 maunds or 6,044 tons.

† Estimated at 2 cwt. per acre, a very low yield. According to Bombay crop experiments the yield is variously stated from 190 to 239 and 360lb an acre or, say, 3 cwt.

in Linseed Oil. (*G. Watt.*) LINUM usitatissimum.

TRADE.

Internal. 72 449

The total amounts of linseed shown as carried by rail and river, were in 1888-89 said to have been 1,14,08,389 maunds, valued at R4,35,19,349. The largest exporting province was Bengal with 54,05,056 maunds, the bulk of which went to Calcutta to meet the foreign trade from that port. Next in importance as exporting were the North-West Provinces and Oudh with 26,87,088 maunds, of which over 20,00,000 maunds also went to Calcutta. Bombay exported 7,55,052 maunds, of which nearly the whole went to its port town to meet the Bombay foreign exports. The Central Provinces, Berar, Rájputana, and Central India each exported nearly similar quantities and to the port town of Bombay. Thus it will be seen that the foreign exports from Calcutta are drawn from the Bengal Province and the North-West Provinces; the total imports into Calcutta from all sources amounted in 1888-89 to 75,22,764 maunds, while those into Bombay came to 36,51,935.

The supplies drawn by Calcutta and Bombay (the chief marts in the foreign trade) are also slightly augmented by the coastwise transactions, particularly in the case of Bombay. For example, in the year 1888-89, Bombay received from Sind 1,794 cwt., valued at R11,154; from Goa 32,878 cwt., valued at R1,97,736; from Cambay 3,037 cwt., valued at R19,257; and from Kathiawar 129 cwt., valued at R783. It will thus be seen that the linseed exported from Bombay is drawn from Bombay Presidency, Sind, the Central Provinces, Berar, Rájputana, Goa, and Kathiawar. The Panjáb produces very little linseed, but doubtless what it does yield finds its way to Calcutta along with that from the North-West Provinces. From the above review of the internal trade in linseed it may be admitted to have been shown that the most extensive areas of production are Bengal and the North-West Provinces. This idea is confirmed by an inspection of the details of the total amount (8,461,374 cwt.) of the foreign exports, from which it will be seen that Bengal (*i.e.*, Calcutta) exported 5,659,492 cwt.; Bombay 2,797,246 cwt.; Sind 675 cwt.; and Madras 3,961 cwt. Of these foreign exports the United Kingdom took 5,295,175 cwt., valued at R3,06,36,195; France 1,375,689, valued at R88,39,664; the United States 712,042 cwt., valued at R44,94,350; and Holland 524,223 cwt., valued at R32,19,603. The balance went to other countries, of which Belgium figures as highest, having taken 218,193 cwt. It will thus be seen that not only has the Indian export trade in linseed increased during the past fifty years until it has assumed a gigantic form, but that the European demand has been the chief and only cause of this expansion. In 1851 (less than forty years ago) the total demand in Great Britain for linseed amounted to only 630,471 cwt., whereas last year India alone furnished the United Kingdom with 5,295,175 cwt.

Coastwise. 72 450

Statistics cannot be obtained for the present or past Indian consumption of linseed, but it has certainly not materially increased during the past forty years, for no large and new industrial uses of linseed have been brought into existence—a statement abundantly proved by the fact that little or no linseed oil is expressed in this country by the Natives. As already remarked, there is practically only one linseed oil-mill in India, and the oil it produces is mainly, if not entirely, used up by exotic demands, since the people of India use only the small quantity of linseed necessary for the house paint employed by the well-to-do. The bulk of the people of India have not now, nor apparently did they ever have, any very important use for linseed or linseed oil—a statement confirmed by the want of definite historic evidence of cultivation between the development of present foreign trade in linseed and the classic records of the uses of flax, or what most writers accept as flax in Sanskrit literature.

L. 72 450

(*J. Murray.*)

LIPPIA, *Linn.; Gen. Pl., II., 1142.*

[*1463;* VERBENACEÆ.

451 73 **Lippia nodiflora,** *Rich.; Fl. Br. Ind., IV., 563; Wight, Ic., t.*

Syn.—VERBENA NODIFLORA, *Linn.*; V. CAPITATA, *Forsk.*; BLAIRIA NODIFLORA, *Gærtn.*; ZAPANIA NODIFLORA, *Lamk.*; LANTANA SARMENTOSA *and* REPENS, *Spreng.*; PHYLA CHINENSIS, *Lour.*

Vern.—*Bhúi-okra,* HIND.; *Lúdra,* N.-W. P.; *Mokna, búkan, bakan, jalnim,* dried plant=*gorakh múndí,* PB.; *Wakan,* SIND; *Tan,* DEC.; *Ratolia,* BOMB.; *Ratoliyá,* MAR. & GUZ.; *Podútalei,* TAM.; *Bokenakú,* TEL.; *Herimanadatta,* SING.; *Vashira,* SANS.

References.—*Dalz. & Gibs., Bomb. Fl., 198; Stewart, Pb. Pl., 166; Ainslie, Mat. Ind., II., 313; Dymock, Mat. Med. W. Ind., 2nd Ed., 599; Honigberger, Thirty-five Years in the East, II., 300; S. Arjun, Bomb. Drugs, 105; Murray, Pl. and Drugs, Sind, 175; Atkinson, Him. Dist., 315; Ind. Forester, XII., 19; Gazetteers:—N.-W. P., I., 83; IV., lxxvi.*

Habitat.—An evergreen undershrub, common in wet places throughout India and Ceylon, distributed to all tropical and warm-temperate regions.

MEDICINE. Stalks. 452 74 Leaves. 453 75 Medicine.—Ainslie writes: "The tender STALKS and LEAVES of this low-growing plant, which last are in a slight degree bitter, the native practitioners prescribe, when toasted, in cases of children's indigestion, to the extent of two ounces in infusion, twice daily; it is also ordered as a drink for women after lying-in." Stewart states that it is considered cooling by the natives of the Panjáb, but in the time of Honigberger it appears to have been regarded as of very little medicinal value. He writes: "The natives know the plant, but very seldom use it." He himself considered it valuable in "Ischury, stoppage of the bowels, and pain in the knee-joint." Dymock states that it is used in Bombay as a demulcent in cases of gonorrhœa.

Liqueurs, see Spirits, Vol. VI.

LIQUIDAMBAR, *Linn.; Gen. Pl., I., 669.*

454 76 **Liquidambar Altingia,** *Bl.;* see Altingia excelsa, *Noronha;* Vol. I., 201.

455 77 **L. orientalis,** *Miller; DC., Prodr., XVI, 158;* HAMAMELIDEÆ.

LIQUID STORAX, LIQUIDAMBAR, ROSE MALLOES.

Syn.—LIQUIDAMBAR IMBERBE, *Aiton.*

Vern.—*Siláras, meih-síla, nágorigond,* HIND.; *Silha, silaras,* BENG.; *Siláras, salajet, usturuk,* BOMB.; *Silarasa,* MAR.; *Meih-síla, seláras,* GUZ.; *Neri-arishippál,* TAM.; *Shilá-rasam.* TEL.; *Rasamalla,* MALAY.; *Nantayu,* BURM.; *Rasamalla,* MALAYS.; *Silhaka,* SANS.; *Miah-sáyelah, usteruck, meati-lubani, salajet, meah, sillarus, cotter mija,* ARAB.; *Meih-síla, asle-lubní,* PERS.

References.—*Gamble, Man. Timb., 174; Ainslie, Mat. Ind., I., 405; O'Shaughnessy, Beng. Dispens., 255, 610; Moodeen Sheriff, Supp. Pharm. Ind., 169; U. C. Dutt, Mat. Med. Hind., 166, 318; Dymock, Mat Med. W. Ind., 2nd Ed., 313; D. Hanbury, in Pharm. Jour., XVI., 417, 461; XXII., 436; Flück. & Hanb., Pharmacog., 271; U. S. Dispens., 15th Ed., 1373, 1686; Bent. & Trim., Med. Pl., 107; S. Arjun, Bomb. Drugs, 130; Year Book Pharm., 1874, 293; Birdwood, Bomb. Pr., 81; Balfour, Cyclop., II., 721; Smith, Dic., 247; Ind. Forester, II., 181, 408; X., 435.*

Habitat.—"A handsome, umbraceous tree, resembling a plane, growing to the height of 30 to 40 feet or more, and forming forests in the extreme south-western part of Asia Minor. In this region the tree occurs in the district of Singhala, near Melasso, about Budrum (the ancient Halicarnassus), and Monghla, also near Giova and Ullá in the Gulf of Giova,

Liquid Storax. (*J. Murray.*) LIQUIDAMBAR orientalis.

and lastly near Marmorizza and Isgengak opposite Rhodes." "The tree is not known to grow in Cyprus, Candia, Rhodes, Kos, or indeed in any of the islands of the Mediterranean" (*Hanbury*).

MEDICINE. Resin. 78 456

Medicine.—LIQUID STORAX has long formed an important article of medicine in this country; indeed, Flückiger & Hanbury state that as early as the first century it was exported by the Red Sea to India. For many centuries it has been, and still continues to be, an important article of export from Bombay to China. Hanbury's investigations have proved that the solid storax of the ancients, which was derived from **Styrax officinale**, *Linn.*, and was always scarce and valuable, has, in modern times, entirely disappeared from commerce, and has been replaced by the balsam now under consideration.

The method of extraction and preparation is described by Hanbury as follows:—"The extraction of Liquid Storax is carried on in the forests of the south-west of Asia Minor, chiefly by a tribe of Turcomans called *Yuruks*. The process has been described on the authority of Maltass and McCraith of Smyrna, and of Campbell, British Consul at Rhodes. The outer bark is said to be first removed from the trunk of the tree and rejected: the inner is then scraped off with a peculiar iron knife or scraper, and thrown into pits until a sufficient quantity has been collected. It is then boiled with water in a large copper, by which process the resin is separated, so that it can be skimmed off. This seems to be performed with sea water; some chloride of sodium can therefore be extracted from the drug. The boiled bark is put into hair bags, and squeezed under a rude lever, hot water being added to assist in the separation of the resin, or, as it is termed, *yagh, i.e.*, 'oil.' Maltass states that the bark is pressed in the first instance *per se*, and afterwards treated with hot water. In either case the products obtained are the opaque, grey, semi-fluid resin known as Liquid Storax, and the fragrant cakes of foliaceous brown BARK, once common, but now rare in European Pharmacy, called "Cortex Thymiamatis."

Bark. 79 457

DESCRIPTION.—The balsam is a soft, viscid resin, usually of the consistence of honey, heavier than water, and greyish-brown in colour. It always contains water which by long standing rises to the surface. When heated it becomes dark brown and transparent; when spread out in a thin layer, it partially dries but does not lose its stickiness. When free from water it dissolves in alcohol, spirit of wine, chloroform, ether, glacial acetic acid, bisulphide of carbon, and most of the essential oils. It possesses a pleasant balsamic smell when old, but when recent, has an unpleasant odour of bitumen or naphthalin. Its taste is sharply pungent, burning, and aromatic.

CHEMICAL COMPOSITION.—For an account of the composition of this drug, which, not being of Indian origin, need not be fully discussed in this work, the reader is referred to the exhaustive description in Flückiger & Hanbury's standard work. It may be mentioned, however, that the principal constituents are *styrol*, a colourless, volatile, liquid hydrocarbon; *styracin*, a crystalline solid; *cinnamic acid*; a *resin*, and an *essential oil*.

THERAPEUTICS.—Liquid Storax is a stimulant expectorant like the Balsams of Peru and Tolu, and Benzoin, but except as a constituent of the Compound Tincture of Benzoin, is, at the present day, little prescribed in European medicine. Locally applied it is stimulant, antiseptic, and disinfectant, and has been much advocated of late years as an application for scabies and phthiriasis. For this purpose it is mixed with olive or linseed oil. It is interesting to find that this property of the drug appears to have been known to old Sanskrit writers, by whom it was considered "useful in affections of the throat, copious perspiration, and skin diseases" (*U. C. Dutt*). By Muhammadan physicians it is esteemed as a tonic, resolvent, suppura-

MEDICINE.

tive, and astringent. Thus Dymock writes: "It is prescribed as a pectoral, and is thought to strengthen all the viscera; applied externally it is supposed to have a similar action upon the parts with which it comes in contact. It is a favourite application to swellings, and in Bombay is much used in orchitis, the inflamed part being smeared with it, and bound up tight in tobacco leaves." It is also largely used in perfuming medicinal oils. **Altingia excelsa** (*Vol. I., 201*) yields a very similar resin, which has been said to equal, in its medicinal properties, that now under consideration. Waring, however, wrote in the *Pharmacopœia of India*, that he had tried it as an expectorant without satisfactory results, and that, as far as his experience went, it appeared to be of little value medicinally.

TRADE.

Trade.—As this drug is not returned separately in the statistical tables of imports, the total trade in the article cannot be specified. Dymock states, however, that the imports into Bombay in 1881-82 amounted to 363 cwt. from the Red Sea ports, and valued R16,154. It is probable that a considerable proportion was re-exported to China.

Liquorice, see **Glycyrrhiza glabra,** *Linn.*; Vol. III., 512.

Liquors, see **Malt Liquors,** p. 124.; also **Spirits,** Vol. VI.

Litharge, see **Lead,** Vol. IV., 602.

LITHOGRAPHIC STONES.

Lithographic Stones, *Geol. of Ind., III.* (*Economic, Ball*), *556.*

References.—*Baden Powell, Pb. Prod., 45; Balfour, Cyclop. Ind., II., 728; in Sel. Rec., Mad. Govt (1865), II., 38; Adm. Rep., C. Prov., 80.*

DISTRIBUTION.

Distribution.—Stones suitable for lithographic purposes are at present almost entirely imported from Europe and are sold by weight at high prices. An indigenous stone of this description is a great desideratum, since most native printing is by lithograph. This fact, combined with the high price of European stones, led to trials being made of Indian material soon after the introduction of lithography in 1822. Stones with the necessary qualities, however, are not of wide distribution; and since most of the limestones in India belonged to the more or less altered series of transition rocks, they were found to be hard, splintery, and difficult to dress and polish. They have accordingly proved only fitted for rough work, and, as Ball writes, "The fact that they are not used, at least to any appreciable extent, while high prices continue to be paid for European stones, is the strongest argument against their being of any substantial value."

The following are enumerated by Ball as the localities from which lithographic stones are said to have been obtained in India:—

Madras.

Madras.—Bellary, Karnul, Guntur, and Masulipatam. The best appear to have been derived from the metamorphosed limestone of the Karnul district, but even these are harder, more splintery, and less tractable than European stone.

Bengal.

Bengal.—The limestones of the Lower Vindhyan series early attracted attention, but are not sufficiently pure and homogeneous to be depended on.

Rewah.

Rewah.—In 1843 small samples from Búrwa were sent to the Asiatic Lithographic press and were favourably reported on, but further research appears to have proved them to be unsatisfactory.

Central Provinces.

Central Provinces.—Stones of a serviceable kind have been found in Raipur, and were at one time used in the jail press of that district.

Rajputana.

Rájputana.—Ball writes: "Of all the suggested substitutes of indigenous stone for that imported, a yellow limestone obtained in the Jesalmir State appears to have been of greatest promise" Attention was first drawn

Litmus. (*J. Murray.*)

LITSÆA elongata.

to it, about sixty years ago, by Captain Boileau in *Gleanings in Science, I.*, and the *Indian Review, III.* He stated that it was not suited for fine chalk drawings, but could be used for all other purposes with the ordinary materials. The chief point dwelt upon is the method of polishing which it was found necessary to adopt. The stone, being hard, brittle, and semi-crystalline, could not be polished with the ordinary sleek stone and pumice, but rubbers of lac and corundum, coarse, then medium, then fine, followed by polishing with calcined peroxide of tin, were found to produce good results.

DISTRIBUTION.

Bombay.—The limestones of the Kaladgi and Bhima series have been tried, but have failed to give rise to a demand.

Bombay. 87 465

Panjáb.—Baden Powell writes: "Some kinds of native stone are in use, but the European are always preferred for the finer kinds of work, and where great sharpness of delineation is required in the print."

Panjab. 83 466

Ball, in summing up the remarks from which the above has been condensed, writes: "It would seem, judging from the geology, that in the Salt-range and in Cutch, there are better chances of finding a limestone suitable for the purpose than anywhere else in India." It may be mentioned that the best European stones are obtained in quarries in the oolitic rocks of Solenhofen near Munich, and in Pappenheim on the Danube. A perfect stone is compact and homogeneous, free from veins, flaws or spots, and of an even grey or drab colour.

LITHOSPERMUM, *Linn.; Gen. Pl., II., 860.*

[BORAGINEÆ.

Lithospermum officinale, *Linn.; Fl. Br. Ind., IV., 175;* 89 467

Syn.—MAGAROSPERMUM OFFICINALE, *Dcne.*

Vern.—Seeds=*Lubis firmun*, HIND.

References.—*Royle, Ill. Him. Bot., I., 304; Stewart, Bot. Tour in Hazara, &c., in Jour. Agri.-Hort. Soc. of Ind. (Old Series), XIV., 6; Aitch., Bot. Afgh. Del. Com., 90; O'Shaughnessy, Beng. Dispens., 497; Balfour, Cyclop., II., 728.*

Habitat.—An erect undershrub or herb, frequent in Kashmír at altitudes of 5,000 to 8,000 feet.

Medicine.—O'Shaughnessy writes: "The SEEDS are long, very white, and like small stones or pearls, on which account they have been popularly used as a remedy for stone."

MEDICINE. Seeds. 90 468

Litmus.—A blue dye, prepared chiefly in Holland from the orchil-yielding lichen Roccella tinctoria; see Lichens, Vol. IV., 636.

LITSÆA, *Lam.; Gen. Pl., III., 161.*

A genus of evergreen, rarely deciduous, trees or shrubs, which comprises some 140 species, native of Tropical and Eastern Asia, Australasia, and the Pacific Islands; rare in Africa and America. Of these 65 are indigenous to India and Ceylon. The economic information relating to this genus has, as a rule, been detailed by Indian writers under the names of various species of Tetranthera. 93 469

Litsæa elongata, *Wall.; Fl. Br. Ind., V., 165;* LAURINEÆ. 92 470

Syn.—DAPHNIDIUM ? ELONGATUM, *Nees;* TETRANTHERA SIKKIMENSIS, *Meissn., in part.*

Vern.—*Paieli, púalay, phusri*, NEP.; *Phamlet*, LEPCHA.

References.—*Gamble, Man. Timb., 312; List of Trees, Shrubs, &c., of Darjiling, 65.*

Habitat.—A bush or small tree, native of the Subtropical and Temperate Himálaya, from Garhwál to Bhután, also of the Khásia mountains at altitudes from 5,000 to 6,000 feet.

L. 92 470

LITSÆA polyantha. — A Useful Timber.

TIMBER.
471 98

Structure of the Wood.—Gamble describes Daphnidium elongatum, *Nees*, which has been reduced to this species in the *Flora of British India*, as a "large evergreen tree." It is possible, therefore, that the following description of the wood, and the vernacular names above enumerated, may in reality belong to another species. According to Gamble the timber is "yellow, turning olive-grey on exposure, moderately hard, even-grained, weight 34 to 41lb per cubic foot. A very pretty wood, worthy of attention; used for building, chiefly as planking."

472 94

Litsæa grandis, *Wall.; Fl. Br. Ind., V., 162.*

Syn.—TETRANTHERA GRANDIS, *Meissn.*; POLYADENIA GRANDIS, *Nees.*

Reference.—*Kurz, For. Fl. Burm., II., 299.*

Habitat.—An evergreen tree, from 20 to 40 feet in height, not uncommon in tropical forests all over Pegu, Martaban, and Upper Tenasserim; found also in Penang, Malacca, and Singapore.

TIMBER.
473 95

Structure of the Wood.—"Yellow with a beautiful lustre, rather heavy, close-grained, very soft, a fine fancy wood" (*Kurs*).

474 96

L. polyantha, *Juss.; Fl. Br. Ind., V., 162.*

Syn.—LITSÆA MONOPETALA, *Pers.*; TETRANTHERA MONOPETALA, *Roxb.*; T. MACROPHYLLA, *Wall.*; T. ALNOIDES, *Miq.*; T. FRUTICOSA and VERTICILLATA, *Ham.*; ? T. SEMECARPIFOLIA, *Wall.*; T. HEXANTHA, *Sieb.*; TOMEX PUBESCENS, *Willd.*

Vern.—*Meda, gwa, singraf, sangran, marda, kat marra, kakúri, kerauli, patoia, katmoria, papria, katmedh, kari, rand-kari*, HIND.; *Bara kúkúr chita*, BENG.; *Pojo*, SANTAL; *Sualu*, ASSAM; *Huara*, KACHAR; *Ratmanti, kadmero*, NEPAL; *Suphut*, LEPCHA; *Bát, mugasong*, MICHI; *Bolbek*, GARO; *Mendah, kari, kjera, toska, leja*, GOND.; *Leinja*, KURKU; *Randkarri, katmédh*, OUDH; *Rian, gwá, harein*, bark=*meda lakri*, PB.; *Ranamba*, MAR.; *Nara mamúdi, nara*, TEL.; *Ungdung*, BURM.

References.—*Roxb., Fl. Ind., Ed. C.B.C., 735; Brandis, For. Fl., 380., t. 45; Kurz, For. Fl. Burm., II., 299; Gamble, Man. Timb., 310; Stewart, Pb. Pl., 188; Campbell, Ec. Prod. Chutia Nagpur, No. 8447; Elliot, Fl. Andhr., 129; Ainslie, Mat. Ind., II., 227; Drury, U. Pl., 421; Cooke, Oils and Oilseeds, 80; Indian Forester, V., 212; VI., 239, 301, 316; VIII., 127; Gazetteer, Mysore and Coorg, I., 66.*

Habitat.—An evergreen bush or small tree, from 20 to 40 feet in height, met with from the Panjáb and the Salt Range along the foot of the Himálaya on which it ascends to 3,000 feet, eastwards to Assam and Burma, and southwards to the Satpura Range and Coromandel; distributed to Java and China.

OIL. Seed.
475 97

Oil.—The SEEDS yield an oil, used in the manufacture of candles, also medicinally for ointments.

MEDICINE. Bark.
476 98

Medicine.—Ainslie writes: "The BARK is mildly astringent, and has a considerable degree of balsamic sweetness." "It is used by the hill people in the cure of diarrhœa." Stewart writes: "The bark, with that of Tetranthera Roxburghii, *Nees* (Litsæa sebifera, *Pers.*, *var.* proper), is officinal, being considered stimulant, and after being bruised, applied, fresh or dry, to contusions, and sometimes mixed with milk and made into a plaster." Campbell confirms the above, writing: "The powdered bark is applied to the body for pains arising from blows or bruises, or from hard work; it is also applied to fractures in animals." The SEEDS yield an OIL which is used medicinally. The medicinal properties above enumerated are very similar to those of the better known, and more largely employed, L. sebifera, *Pers.*, the vernacular names for which also strongly resemble—and, indeed, in certain dialects are identical with—those of this species.

Seeds.
477 99
Oil.
478 100

TIMBER.
479 101

Structure of the Wood.—Olive-grey, soft, not durable, soon attacked by insects, weight 38lb per cubic foot, used for agricultural implements (*Gamble*).

A Fibre-yielding Litsæa. (*J. Murray.*) LITSÆA sebifera.

Domestic.—The LEAVES are used in Assam to feed the *muga* silk-worms (Antheræa assama, *Westw.*); they have a cinnamon-like smell when bruised" (*Gamble*). DOMESTIC. Leaves. 480

Litsæa salicifolia, *Roxb.; Fl. Br. Ind., V., 167.* 481

Syn.—TETRANTHERA SALICIFOLIA, *Roxb.*; T. GLAUCA, *Wall.*; T. LAURIFOLIA, *Roxb.*; T. ATTENUATA, *Wall.*; T. LANCEÆFOLIA, *Roxb.* (LANCIFOLIA, *Kurz.*) T. SALICIFOLIA and SALIGNA, *Herb. Ind. Or. H.f. & T.*

Vern.—*Sampat*, NEP.; *Digilati*, MICHI; *Diglotti, sún*, ASSAM; *Chengphisol*, KACHAR.

References.—*Gamble, Man. Timb., 310; Trees, Shrubs, &c., of Darjiling, 65; Kurz, For. Fl. Burm., II., 300; Indian Forester, V., 212; Agri.-Hort. Soc. of Ind., Jour. (Old Series), VI., 29; XIII., 396, 399, 401, 411.*

Habitat.—An evergreen bush or small tree, of Northern and Eastern India, from Oudh and Nepál to Sikkim (ascending to 6,000 feet), met with also in Assam, Bengal, Chittagong, and Pegu.

The *Flora of British India* contains a description of six varieties, which, however, need not be enumerated here, as only one, **var. ellipsoidea**, is reported as possessing economic value.

Domestic.—The LEAVES are employed, like those of **L. polyantha**, to feed the *muga* silkworm in Assam. DOMESTIC. Leaves. 482

L. sebifera, *Pers.*, var. sebifera proper; *Fl. Br. Ind., V., 158.* 483

Syn.—LITSÆA SEBIFERA and TETRANTHERA, *Pers.*; L. MULTIFLORA, *Blume*; L. CHINENSIS, *Lamk.*; TETRANTHERA LAURIFOLIA, MULTIFLORA, RACEMOSO-UMBELLATA, and ROXBURGHII, *Blume*; T. LAURIFOLIA, *? Jacq.*; T. ROXBURGHII, *Nees*; T. CAPITATA, *Herb. Roxb.*; T. APETALA, *Roxb.*; TOMEX TETRANTHERA and SEBIFERA, *Willd.*; SEBIFERA GLUTINOSA, *Lour.*; LAURUS INVOLUCRATA, *Kœnig.*; GAJA NIPELLI, *Jones.*

This species is divided into three varieties in the *Flora of British India, viz.*, 1, sebifera proper, 2, glabraria, and 3, tomentosa. Of these only the first, of which the synonyms have been above detailed, is of economic value.

Vern.—*Garbijaur, singrauf, medh, ménda*, bark=*maidá-lakri*, HIND.; *Kúkúr chita, ratún, garur*, bark=*maidá-lakri*, BENG.; *Suppotnyok*, LEPCHA; *Garbijaur, singrauf*, N.-W. P.; *Medh*, OUDH; *Medasak, chandna, gwá, riún, medachob*, bark=*méda-lakri, maidasak*, PB.; *Ménda*, C. P.; bark=*Maida-lakri*, leaves=*chickana*, BOMB.; bark=*Mirio*, GOA; *Maidá-lakadí*, MAR.; bark=*Maida-lakti, mushaippé-yetti, pishin-pattai*, TAM.; *Narra alagi, nara mamidi, meda*, TEL.; *Ong-tong, ung-dung, ungdungnet*, BURM.; bark=*Maghase-hindi*, ARAB.; bark=*Kilz*, PERS.

References.—*Roxb., Fl. Ind., Ed. C.B.C., 734, 735; Brandis, For. Fl., 319; Kurz, For. Fl. Burm., II., 298; Gamble, Man. Timb., 310; Thwaites, En. Ceylon Pl., 255; Stewart, Pb. Pl., 188; Elliot, Fl. Andhr., 114, 129; Campbell, Ec. Prod. Chutia Nagpur, No. 9821; O'Shaughnessy, Beng. Dispens., 548; Moodeen Sheriff, Supp. Pharm. Ind., 243; Dymock, Mat. Med. W. Ind., 2nd Ed., 671; Murray, Pl. and Drugs, Sind, 111; Irvine, Mat. Med., Patna, 64; Honigberger, Thirty-five Years in the East, II., 357; Baden Powell, Pb. Pr., 374, 600; Atkinson, Him. Dist., 316, 751; Birdwood, Bomb. Pr., 74; Cooke, Oils and Oilseeds, 79; Agri.-Hort. Soc. of Ind., Jour. (Old Series):—IV., Sel., 260; X., 33; XIII., 318, 319; (New Series):—I., 102; V., 71; Indian Forester:—III., 204; VI., 239, 301, 303, 304; X., 325.*

Habitat.—An evergreen tree of very variable habit, foliage, and inflorescence, widely distributed throughout the hotter parts of India.

Fibre.—M. Dumaine states that the red ROOTS are employed as a paper material, and also for making a strong string in Hazaribagh (*Agri.-Hort. Soc. of Ind. Jour. (New Series), I., 71*). FIBRE. Roots. 484

OIL.
485

Oil.—An oil, obtained from the FRUIT, is employed in China and Java in the manufacture of candles. Baden Powell states that "it is used to make ointment and candles," but does not mention whether the latter observation refers to the Panjáb or not. No Indian author confirms his statement, and it appears probable that the greasy exudation is, in this country, utilised only medicinally.

MEDICINE.
Bark.
486

Medicine.—The feebly balsamic, mucilaginous BARK is one of the best known and most popular of native drugs. Dymock states that it does not appear to have been mentioned by Sanskrit writers, and is only briefly noticed in Muhammadan works. He considers it probable that the drug has been adopted by Muhammadan physicians in India as a substitute for an Arabian drug, called *Maghath*, the botanical source of which is uncertain. At the present time it is largely employed as a demulcent and mild astringent in diarrhœa and dysentery. According to Irvine it is also esteemed as an aphrodisiac in Patna. Fresh ground, it is used either dry, or triturated in water or milk, as an emollient application to bruises, and as a styptic dressing for wounds. It is also supposed to be anodyne, and to act as a local antidote to the bites of venomous animals.

Oil.
487
Leaves.
488
TIMBER.
489
490

The OIL from the berries is used in rheumatism; the LEAVES are mucilaginous and have a pleasant odour of cinnamon.

Structure of the Wood.—"Greyish-brown, or olive-grey, moderately hard, shining, close and even-grained, seasons well, is durable and not attacked by insects. A fine wood, worth notice" (*Gamble*).

Litsæa umbrosa, *Nees; Fl. Br. Ind., V., 179.*

Syn.—LITSÆA CONSIMILIS, *Nees;* TETRADENIA UMBROSA and CONSIMILIS, *Nees;* TETRANTHERA UMBROSA, *Wall.;* T. PALLENS, *Don.*

Vern.—*Púteli*, NEP.; *Chira, chir-chira*, KUMAON; *Kanwal* (*a*), *tilbora, sara, jhatela, chírara, chírchíra*, N.-W. P.; *Chírudi, chindi, chilotú raulí, shalanglú, charká*, PB.

References.—*Brandis, For. Fl., 382; Gamble, Man. Timb., 311; Trees, Shrubs, &c., of Darjiling, 65; Stewart, Pb. Pl., 188; Cooke, Oil and Oilseeds, 55.*

Habitat.—A small tree met with on the Temperate and Sub-tropical Himálaya from Kashmír to Sikkim, at altitudes of 3,000 to 7,000 feet, also on the Khásia mountains from 5,000 to 6,000 feet; distributed to Munnipur.

OIL.
Fruit.
491

Oil.—A considerable amount of confusion appears to exist in the literature of Indian Economic Botany regarding an oil-yielding Litsæa. Stewart described an undetermined species in his *Panjáb Plants* as bearing an oil-yielding FRUIT. Brandis gives the same vernacular Panjáb names for the species now under consideration, as those enumerated by Stewart for his undetermined species, and states that the fruit yields an oil used for burning. He, however, unites L. zeylanica, *Nees*, with L. consimilis, *Nees*, and L. umbrosa, *Nees*, as one species, which appears to have led Gamble to make the mistake of stating that the first mentioned species also yields an oil used for burning. The writer can find no other reference to an oil obtained from L. zeylanica, and it appears probable that Gamble has inadvertently over-looked the fact that Brandis, though uniting the species, has been careful to describe the oil as obtained only from L. consimilis. Similarly Gamble, in his list of vernacular names for L. zeylanica (which he agrees with the *Flora of British India* in considering distinct), has enumerated the Panjábi and North-Western Provinces names of L. umbrosa. In this he is evidently mistaken, since L. zeylanica does not occur north of the Konkan.

TIMBER.
492

Structure of the Wood.—"Yellow, moderately hard, close-grained, weight 43lb per cubic foot; a good wood" (*Gamble*).

[*1844, 1845.*

Litsæa zeylanica, *Nees; Fl. Br. Ind., V., 178; Wight, Ic., tt. 132,* 493

Syn.—LITSÆA OBLONGA, *Nees;* L. STRIOLATA, *Blume;* L. FOLIOSA, *Nees;* L. FURFURACEA, *Nees;* L. SCROBICULATA, *Meissn.;* L. TRINERVIA, *Juss.;* TETRADENIA CEYLANICA; FURFURACEA and FOLIOSA, *Nees;* TETRANTHERA FOLIOSA, PULCHERRIMA (*in part*) and FURFURACEA, *Wall.;* LAURUS CASSIA, *Linn.;* L. INVOLUCRATA, *Vahl.;* L. ZEYLANICA, *Herm.*

Vern.—*Belori,* NILGHIRIS; *Dawal kúrúndú,* SING.

References.—*Brandis, For. Fl., 382; Kurz, For. Fl. Burm., II, 306; Beddome, Fl. Sylv., t. 294; Gamble, Man. Timb., 311; Thwaites, En. Ceylon Pl., 257; Dalz. & Gibs., Bomb. Fl., 223; Lisboa, U. Pl. Bomb., 113; Gazetteer:—Bombay, XV., 441; Ind. Forester, II, 23; III., 204.*

Habitat.—A small tree with variable foliage, met with in Bhután, the Khásia mountains, Sylhet, Chittagong, Pegu, Tenasserim (ascending to 7,000 feet), and Martaban, also on the Western Coast from the Konkan southwards, and from Quilon to 7,000 feet in altitude on the Nilghiris; distributed to Ceylon, Penang, Malacca, Java, and Sumatra.

Oil.—See remarks under the preceding species. OIL.

Structure of the Wood.—"Reddish-white, with darker heartwood, moderately hard, growth slow, weight 36 to 38lb per cubic foot" (*Gamble*). 494 TIMBER.

In Southern India it is used, according to Beddome, "for house-building purposes, planks, rafters, &c., being straight-grained and tough." 495

LIVERWORTS.

Liverworts, *Mitten, Indian Hepaticæ, in Jour. Linn. Soc., V., 89-128; Baillon, Bot. Med. Crypto., 51-55.* 496

The LIVERWORTS or HEPATICÆ constitute a group of the non-vascular Cryptogams, allied to the Mosses. They are cosmopolitan in range, but exist in greatest number in moist cool climates. Consequently, though they are to be found in nearly all moist parts of India, their number and relative importance in the vegetation increase from the plains to the temperate regions of the hills, and the Alpine Himálaya. But few are of any economic value, and, so far as the writer is aware, none are used in any way in India.

The following are the species that have been considered useful:—

Marchantia polymorpha, *Linn.; Mitten, in Jour. Linn. Soc., V., 125.* MEDICINE.

One of the commonest of liverworts; found on the North-Western Himálaya from Jamu to Sikkim, between the altitudes of 6,000 and 14,000 feet. This species has been vaunted, more than any other, as a remedy for affections of the liver. It has also been described as a valuable medicine in certain chronic skin affections, phthisis, and anasarca. 497

Fegatella conica, *Corda; Mitten, 126.*

Occurs in the North-Western Himálaya and Western Tibet, between 7,000 and 10,000 feet. At one time a decoction of this liverwort was held in high repute as a remedy for calculous complaints, and as a diuretic. Certain species of **Jungermannia** have had antiscorbutic and antisyphilitic properties ascribed to them, due to the iodine contained in their fronds, and members of the genera **Riccia** and **Anthoceros** have also been considered of medicinal value.

From the gradual disuse into which these remedies have fallen, however, it would appear that the properties assigned to them were all more or less fanciful. The supposed action of many species in diseases of the liver may probably have arisen from a belief in the "theory of signatures." If so, it is all the more remarkable that they are not, and apparently never have been, employed in Indian medicine, in the more remote days of which this theory held such an important position.

LOBELIA nicotianæfolia. — A Useful Palm.

LIVISTONA, *Br.; Gen. Pl., III., 929.*

[*a, b, c, d, App. xxiii.*; PALMÆ.

Livistona Jenkinsiana, *Griff., Palms of Brit India, 128, Pl. 226,*

Vern.—*Toko pat*, ASSAM; *Tailainyom, tulac-myom, porbong*, LEPCHA; *Htan-myouk-lu*, BURM.

References.—*Kurz, For. Fl. Burm., II., 525; Gamble, Man. Timb., 418; Trees, Shrubs, &c., of Darjiling, 86; Royle, Fibrous Pl., 97.*

Habitat.—A palm 20 to 30 feet in height, with a thick, round crown, commonly met with throughout Assam, but most plentiful in theNowgong District.

DOMESTIC. Domestic, &c.—Griffith writes: "Major Jenkins tells me that 'this palm is an indispensable accompaniment of every native gentleman's house, but in some parts it is rare and the trees are then of great value.' I cannot call to my recollection having ever seen a *Toko* tree undoubtedly wild.

Leaves. The LEAVES are in universal use throughout Assam for covering the tops of *doolees* (palanqueens), and the roofs of boats, also for making the peculiar hats, or rather umbrella-hats (*jhapees*) of the Assamese. For all these purposes the leaves are admirably adapted by their lightness, toughness, and durability." The leaves are similarly employed by the Lepchas for thatching and umbrellas.

L. speciosa, *Kurz; For. Fl. Burm., II., 526.*

Vern.—*Thau*, MAGH.; *Tawtan*, BURM.

References.—*Kurz, Ind., Jour. As. Soc. Beng., xliii.; Fl. Burm., II., 204; Gamble, Man. Timb., 418.*

Habitat.—An evergreen lofty palm, frequent in the tropical forests of Chittagong, the eastern and southern slopes of the Pegu Yomah, and Upper Tenasserim.

DOMESTIC. Leaves. Domestic.—Gamble states that the LEAVES of this species are sometimes used for thatching in Chittagong instead of those of Licuala.

Lizards, see Reptiles, Vol. VI., Pt. I.

LOBELIA, *Linn.; Gen. Pl., II., 551.*

A genus of herbs or shrubs which comprises about 200 species, natives, for the most part, of America and South Africa. Fifteen are indigenous to India. One American species, **L. inflata**, *Linn.*, is of interest, since the dried flowering herb constitutes the Lobelia of medicine. This drug is much used in European practice as an expectorant, and to depress the respiratory centre and relax the bronchial muscles in asthma and whooping cough. In full doses it is diaphoretic, diuretic, and emetic, but is too powerful and dangerous an agent to be esteemed for these properties. The drug is officinal in the macopœia of India, and is imported from America, through pressed, oblong, rectangular packages.

[*Ill., t. 135;* ...

Lobelia nicotianæfolia, *Heyne; Fl. Br. Ind., III.*

Syn.—RAPUNTIUM NICOTIANÆFOLIUM, *Presl.*

Var., trichandra,—L. TRICHANDRA, *Wight.*

Vern.—*Deonal, bokenal, dhaval, dawal*, BOMB.; ...

References.—*Roxb., Fl., Ind., Ed. C.B.C., 170; Thw... Pl., 170; Dalz. & Gibs., Bomb. Fl., 133; O'Shaug... pens., 424; Dymock, Mat. Med., W. Ind., 2nd Ed., Bomb. Drugs, 81; Lisboa, U. Pl. Bomb., 265; Gazette... Coorg, I., 56; III., 17; Bombay, XV., 436.*

Habitat.—An erect herb met with in Malabar, on t... Bombay to Travancore at altitudes of 3,000 to 7,000 feet, a...

MEDICINE. Medicine.—This species is said by Roxburgh to have been first described by Heyne, who found it near Bangalore. Little appears to be known

L. 506 504

regarding its medicinal properties, but the statement is made in the *Indian Pharmacopœia* that an infusion of the LEAVES is antispasmodic. The dry HERB and SEEDS are said to be extremely acrid, and according to Dymock the dust of the former irritates the throat and nostrils like tobacco. Lisboa states that the seeds contain an acro-narcotic poison, and that they are said to be preferred to Datura as a poison, when rapid effect is desired. No mention is made of the plant in native medical works, indeed it would appear to be more widely known as a poison, than esteemed as a drug.

MEDICINE. Leaves. 505 Herb. 506 Seeds. 507

Domestic.—Graham states that the dried hollow STALKS are sold in the bazár at Mahableshwar, and are used as *Koluri* horns (called *pánwá* in the Konkan), for collecting herds of cattle and for scaring wolves. According to Gibson the Mahratta name *deonal* is probably given to the plant in allusion to the stems being similarly used as reeds for incantations (*Dymock*).

DOMESTIC. Stalks. 508

Lobelia trigona, *Roxb.; Fl. Br. Ind., III., 423; Wight, Ic., t. 1170.* 509

Syn.—L. TRIANGULATA, *Roxb.*; L. STIPULARIS, *Roth.*; L. GRATIOLOIDES, *Roxb.*; L. SP., *Griff.*

Vern.—*Chauric arak*, SANTAL.

References.—*Roxb., Fl. Ind., Ed. C. B.C., 170; Dalz. & Gibs., Bomb. Fl., 133 (excl. syn.); Campbell, Ec. Prod., Chutia Nagpur, Nos. 7837, 9854, 9869; Gazetteers:—Bombay, XV., 436; N.-W. P., IV., lxxiii., X., 312.*

Habitat.—An annual herb, common in the Deccan and Ceylon from the sea level to 6,000 feet, found also in Assam, Bengal, and Burma.

Food.—Campbell states that the LEAVES are eaten as a pot-herb in Chutia Nagpur.

FOOD. Leaves. 510

Locusts, see Insects, Vol. IV., 470; also Pests, Vol. VI.

Lodh Bark, see Symplocos racemosa, *Roxb.*; STYRACEÆ; Vol. VI.

LODOICEA, *Labill.; Gen. Pl., III., 939.*

[7, 8; PALMÆ. 511

Lodoicea Sechellarum, *Comm. & Labill., Bot. Mag., 2734, 5, 6,* THE SEA COCOANUT; THE DOUBLE COCOANUT; COCOS DE MER, *Fr.*

Vern.—*Daryá-ká-náriyal*, HIND.; *Daryá-ká-náriel*, DEC.; *Jáhari-naral*, BOMB.; *Kadat-réngáy*, TAM.; *Samudrapu-tenkáya*, TEL.; *Katal-ténná*, MALAY.; *Daryá-nu-nariyal*, GUZ.; *Múdú-pol*, SING.; *Penle-on-si*, BURM.; *Ubdie narikaylum*, SANS.; *Nárjile-bahri*, ARAB.; *Nárgile-bahri*, PERS.

References.—*Brandis, For. Fl., 545; Ainslie, Mat. Ind., II., 126; Moodeen Sheriff, Supp. Pharm. Ind., 169; Dymock, Mat. Med. W. Ind., 2nd Ed., 804; S. Arjun, Bomb. Drugs, 147; Year Book Pharm., 1878, 288; Birdwood, Bomb. Pr., 93; Royle, Fib. Pl., 124; Balfour, Cyclop., II., 734; Treasury of Bot., II., 692; Ind. Forester, VI., 240.*

Habitat.—A tall palm, with a distinctly annulated stem and a crown of from 12 to 20 large leaves, met with in two or three rocky islands of the Seychelle group, north-east of Madagascar. It bears very large fruit, which takes several years to attain maturity, and often becomes from 40 to 50lb in weight.

Medicine.—Long prior to the discovery of the Seychelles the FRUIT which was found floating in the Indian Ocean, and washed ashore by the monsoons, was known and valued in India. Strange accounts of the origin of this mysterious fruit were naturally prevalent, such as that it was produced by some submarine plant. From this belief, and from the fact that it was only found when washed ashore, it obtained its many popular Asiatic and European names, all of which have the same meaning—sea-cocoanut.

MEDICINE. Fruit. 512

Many marvellous medicinal properties were ascribed to these nuts by ancient physicians, both European and Asiatic, and they were consequently sold at high prices. Now-a-days, however, these properties have been

LOLIUM perenne. The Sea-Cocoanut; Rye Grass.

MEDICINE.

recognised as fanciful and dependent solely on the rarity of the fruit. It is consequently no longer valued by Europeans, but **Dymock** informs us that it is still in great repute among the Arabs and natives of India as a tonic, preservative, and alexipharmic. **Ainslie** states that in his time the *Vytians* occasionally prescribed the KERNEL, given in woman's milk, in cases of typhus fever, the dose being "a quarter of a pagoda weight twice daily," and adds, "It is also reputed antiscorbutic and antivenereal." **Dymock** mentions that in Bombay it is prescribed as a tonic and febrifuge in combination with LIGNUM COLUBRINUM (the small branches of **Strychnos colubrina**, *Linn.*). The special opinions below quoted show that it is also reputed to possess several other properties

Kernels. 513

SPECIAL OPINIONS.—§ "*Daryali-naryal* is corrupted in Bombay into *Jehari-naryal*, which means 'poisonous cocoanut,' and is believed to be so by the common people. It is, however, non-poisonous, and is commonly given to children, mixed with the root of nux vomica, for colic. It seems to act mechanically, like Bismuth" (*Assistant Surgeon S. Arjun Ravat, L.M., Girgaum, Bombay*). "It is given by natives, rubbed up with water, to check diarrhœa and vomiting, especially in cholera" (*Assistant Surgeon Bhagwan Das, Rawal Pindi, Panjáb*). "The 'water' of the green fruit or its soft kernel is believed to be antibilious and antacid when taken after meals. The ripe fruit is also used similarly but is at the same time purgative" (*Assistant Surgeon Bolly Chund Sen, Calcutta*).

FOOD. Fruit. 514

Food.—When unripe the inside of the FRUIT containing a transparent jelly-like substance is eaten, but when ripe it becomes horny and useless for food. The crown of the palm is also said to be eaten in the Seychelles.

DOMESTIC. Shell. 515 Down. 516 Canes. 517 Fibres 518 TRADE 519

Domestic.—The hard black SHELL is, in India, carved into ornaments and is also used for *fakirs'* drinking cups. The DOWN attached to the young leaves serves for stuffing mattresses and pillows, the ribs of the CANES and FIBRES of the petiole are used in making baskets, and the young palms are also employed in basket-making.

Trade.—**Dymock** writes:—"The nuts are now an article of export from the Seychelles, hundreds of them may be seen at Port Victoria, Mahé, whither they are brought from the island of Praslin. Value in Bombay R1¼ per lb for the dry kernel. Entire nuts fetch R1 to R2 each according to their size."

Logwood, see Hæmatoxylon campechianum, *Linn.*; Vol. IV., 198.

LOLIUM, *Linn.; Gen. Pl., III., 1202.* 520

A genus of grasses which, according to **Bentham**, comprises two or three species confined to temperate regions of the globe. The members may be readily distinguished from all others of the tribe HORDEÆ by the position of the spikelets on the rachis. They are so placed as to have their margins facing the rachis.

Lolium perenne, *Linn.; Duthie, Fodder Grasses of North India, 68.;* PERENNIAL RAY or RYE GRASS. [GRAMINEÆ. 521

References —*Aitch., Bot. Afgh. Del. Com., 126; Von Müller, Select Plants, 226; Sutton, Permanent and Temporary Pastures, 49; Stebler and Schrotter, Best Forage Pl., 20; Rep. of Experimental Farm, Madras, 1871, 12; Jour. Agri.-Hort. Soc. of India (New Series), V. (Sel.), 59.*

Habitat.—A native of Europe, Northern Africa, and Western Asia, occurring in the Temperate and Alpine Himálaya up to an altitude of 15,000 feet. It is one of the best known of all grasses, is extensively cultivated as a pasture grass, and for hay, and is almost universally selected for lawn-culture. Several varieties occur in cultivation.

CULTIVATION.—This grass, though not perennial on all soils, nor under adverse conditions, is, according to **Sutton**, fully entitled to the name by

Ray or Rye Grass. (*J. Murray.*) LOLIUM perenne.

CULTIVATION.

which it has been known since 1611, the date of the earliest book on agriculture in which it is mentioned.

It thrives best in moist and rich loams and clay, but if the supply of moisture be adequate, can also be grown on loamy sands, as well as on calcareous and marly soils. On rich drained soil it is a success, but on heaths, dry sands, and parched soils, it does not grow well. As a general rule, it requires stiffness as well as moisture in the soil, and can be grown even on the heaviest clays, provided they are drained. One of the best features of the grass as an Indian fodder is the fact that if the soil be fairly compact, drought has little effect upon its vitality. Thus in a dry year in Europe or Australia it has been observed to persist while other grasses have succumbed.

The crop is more benefited than that of any other grass by the application of liquid manure and is also acted on very beneficially by irrigation, provided that the land be also well drained. Experiments in Europe have proved the maximum yield to be obtained in the year after sowing, the total of three cuttings from one acre being 9,300lb of hay. The first cutting is the best. **Drs. Stebler & Schroter** state that one acre of ground requires 55lb of seed, containing 71 per cent. (=38½lb) of pure and germinating grains. The same authors write: "For agricultural purposes perennial rye-grass is rarely sown alone. It may occupy about 80 per cent. of a mixture with white clover. Such a mixture forms the excellent pastures on the alluvial lands of North Germany. If for mowing much lower percentages should be used, especially when the soil is stiff. About 20 per cent. may be used for mixing with clovers to form 'clover grass.' For temporary grass meadows the amount should not exceed 10 per cent.; if permanence is important, 5 per cent. should rarely be exceeded. On a good soil, it should never be entirely absent from any mixture, because of its rapid and dense growth" (*Stebler and Schröter, Best Forage Plants*).

This grass has been introduced into Australia, has spread rapidly, and seems likely to become one of the most important of the pasture grasses in many parts of the country. Thus **Baron F. von Mueller** writes: "Rye grass stands the dry heat of Australian summers fairly well. It is likely to spread gradually over the whole of the Australian continent, and to play an important part in pasture, except in the hottest desert-tracts. It is one of the best grasses to endure traffic on roads or paths, particularly on soil not altogether light, and is also one of the few among important grasses which can be sown at any season in mild climes."

FODDER. L44 522

Fodder.—Though the productive and nutritive powers of the Rye grass are considerably less than those of other meadow hays, its valuable drought-resisting qualities, and its property of rapid growth, render it a most valuable fodder, and one that appears likely to be worthy of extended trial in India.

According to **Wolff**, 100 parts of the hay contain 79·2 of organic matter, consisting of albumen 10·2, fibre 30·2, non-nitrogenous extractives 36·1, and fat 2·7, giving a ratio of nitrogenous to non-nitrogenous nutriment of 1 : 7·3.

Though an excellent fodder and pasture grass, it has been said at times to produce disease in animals fed entirely on it. Thus **F. von Mueller** writes: "Sheep should not be continually kept on rye-grass pasture, as they may become subject to fits similar to those produced by **L. temulentum**, possibly due to the grass getting ergotised or otherwise diseased as many observers assert."

From available records it would appear that the introduction of this grass into India has only been attempted, on at all a large scale, in

FODDER.

Madras. It is therefore disappointing to find the following report issuing from the Saidapet Farm: "The grass is not suited for this climate. It is possible that during a course of years it might be naturalised." Attempts made in the North-Western Provinces and Panjáb might, however, prove much more successful; indeed, a consideration of the nature of soil and climate required by the grass would seem to indicate that Madras, of all parts of India, may present the least favourable conditions to its growth.

523 545 **Lolium temulentum**, *Linn.; Duthie, Fodder Grasses of N. India,* THE DARNEL. [*68.*

Syn.—LOLIUM ARVENSE, *With.*; L. ROBUSTUM, *Reich.*

Vern —*Machní*, HIND.

References.—*Duthie, Indigenous Fodder Grasses of N.-W. Ind., 44; Bent. & Trim., Med. Pl., 295; U. S. Dispens., 15th Ed., 1689; Smith, Dic., 151; Gazetteers, N.-W. P., IV., lxxx; X., 321; Sel. Rec., N.-W. P., 1870, 179.*

Habitat.—An annual weed of cultivation, also occasionally met with as a wayside weed and in waste ground, common in the plains and hills of the North-West Provinces and the Panjáb. It extends throughout Europe and Western Asia, has been found in Madura and North Africa, and occurs as an introduced plant in the United States and Australia.

MEDICINE. Seeds.

524 546 Medicine.—The SEEDS or grains were used medicinally by the ancient Greeks and Romans, but have never been officinal in India, nor in any modern Pharmacopœia. The plant is referred to in this place only because, occurring as a weed of cultivation, its seeds, which are generally supposed to be deleterious, may be found mixed with those of wheat or other cereals. Recent investigations have proved that the darnel grains are, if perfectly healthy and sound, quite inocuous. But they are particularly liable to the attacks of ergot, mildew, and other fungi, and in these conditions, or in certain of them, are poisonous. They then appear to act as a powerful gastro-intestinal irritant, and also to have a marked effect on the cerebro-spinal system, producing headache, giddiness, ringing in the ears. confusion of sight, delirium. convulsions, paralysis, and even death, with severe nervous symptoms. In the report of the Chemical Examiner in the North-West Provinces for 1869 several examples of acro-narcotic poisoning, following the use of wheat mixed with darnel, are cited. The writer of the report recommends that wheat likely to contain the grain should be purified by sifting it through a sieve, the holes of which are small enough to retain the wheat, but large enough to allow the darnel seed to pass through (*Sel. Rec. Govt. N.-W. P., 1870, 179*).

525 547 ## LONICERA, *Linn.; Gen. Pl., II., 5.*

A genus of erect or scandent shrubs, which comprises about 80 species, natives of the Temperate and Sub-Alpine regions of the Northern Hemisphere. Of these 23 are Indian, most of which are small shrubs found in the Himálaya. L. periclymenum, *Linn.*, is the woodbine or honey-suckle, a native of Europe, but cultivated in hill stations as an ornamental climber. Several other members of the genus are also cultivated for forming arbours, and as climbers on walls of houses, &c., for example, L. sempervirens, the Trumpet Honeysuckle.

526 548 **Lonicera alpigena**, *Linn.; Fl. Br. Ind., III., 15;* CAPRIFOLIACEÆ.

Syn.—L. WEBBIANA, *Wall.*; L. OXYPHYLLA, *Edgw.*

References —*Boiss., Fl. Orient., III., 8; Brandis, For. Fl., 256; Gamble, Man. Timb., 217; Stewart, Jour. of a Bot. Tour in Hazára and Khagan, in Jour. Agri.-Hort. Soc. of Ind. (Old Series), XIV., 67; Atkinson, Him. Dist., 311.*

Habitat.—A large shrub of the Himálaya from Kashmír to Kumaon, at altitudes of 9,000 to 12,000 feet; distributed to the European Alps.

A useful Fodder. (*F. Murray.*) LONICERA quinquelocularis.

Structure of the Wood.—Moderately hard, used for firewood. TIMBER. 527 528

Lonicera angustifolia, *Wall.; Fl. Br. Ind., III., 13.*

Vern.—*Mithiga, jinjrú, pílrú, philkú, géang,* PB.

References.—*Brandis, For. Fl., 255; Gamble, Man. Timb., 217; Stewart, Pb. Pl., 113; Atkinson, Him. Dist., 311.*

Habitat.—A small shrub of the Temperate Himálaya from Kashmír and Kumáon to Sikkim, found between 6,000 and 12,000 feet.

Food.—It flowers in May to June, and produces a small, red, sweet FRUIT, which is eaten. FOOD. Fruit. 529

Structure of the Wood.—White, close-grained, hard, weight 60lb per cubic foot (*Gamble*). TIMBER. 530 531

L. glauca, *H.f. & T.; Fl. Br. Ind., III., 11.*

Vern.—*Shingtík, shea, shewa,* PB.

References.—*Stewart, Pb. Pl., 113.*

Habitat.—A dense, wiry undershrub found in the Temperate North-West Himálaya and Tibet, between the altitudes of 12,000 and 16,000 feet.

Medicine.—Stewart states that, in certain parts of Ladák, the SEEDS are given to horses for colic. MEDICINE. Seeds. 532 533

L. hypoleuca, *Done.; Fl. Br. Ind., III., 14.*

Syn.—LONICERA ELLIPTICA, *Royle.*

Vern.—*Kharmo, kodí, zhiko, rapesho,* PB.; *Sperái, gurázáh,* AFG.

References.—*Brandis, For. Fl., 256; Gamble, Man. Timb., 216; Stewart, Pb. Pl., 114; Atkinson, Him. Dist., 311; Royle, Ill., 236.*

Habitat.—A low shrub of the arid tracts of the North-Western Himálaya, at altitudes of 8,000 to 10,000 feet; lately found by Mr. Lace, in Ziárat, South Afghánistán, at an altitude of 8,000 feet.

Fodder.—The LEAVES are said by Stewart to be eaten by goats in the Panjáb, and by Mr. Lace to be considered, in South Afghánistán, a good fodder for camels, goats, and sheep. FODDER. Leaves. 534

L. quinquelocularis, *Hardwicke; Fl. Br. Ind., III., 14.* 535

THE HIMALAYAN HONEY-SUCKLE.

Syn.—LONICERA DIVERSIFOLIA, *Wall.*; L. ROYLEANA, *Wall.*

Vern.—*Bet kukri, bhat kúkra, cheraya, kurmali,* KUMAON; *Tita bateri, pákhur,* KASHMIR; *Phút, bakhrú, khúm, sái, dendrú, klíúnti, kraunti, takla, sbang, rasbam, bijgái, jarlangei, adei,* PB.; *Jarlangai, gurázáh,* PUSHTU.

References.—*Roxb., Fl. Ind., Ed. C.B.C., 181; Brandis, For. Fl., 255; Gamble, Man. Timb., 216; Stewart, Pb. Pl., 114; Jour. Bot. Tour in Hasara, &c., Agri.-Hort. Soc. of India, Jour. (Old Series), XIV. 15, 47; Aitchison, Fl. Kuram Valley, 65; Baden Powell, Pb. Pr., 584; Atkinson, Him. Dist., 311; Gazetteers:—Bannu, 23; Dera Ismail Khan, 19; Ind. Forester, XIII., 68.*

Habitat.—A pubescent shrub of the Temperate Himálaya from Kashmír to Kumáon, between 4,000 and 12,000 feet, also found in the Súlimán range, the hills of the Trans-Indus Panjáb, and Southern Afghánistán.

Fibre.—Aitchison writes in his *Kuram Valley Flora*, "It sheds the external layers of its bark in long fibrous strips, resembling coarse hemp-fibre; this is collected and employed as rope, but has little or no strength, only suitable for stuffing mattresses and such purposes." FIBRE. 536

Structure of the Wood.—White, with a brown centre, very hard and close-grained, weight 52lb per cubic foot, used only for fire-wood (*Gamble*). Mr. Lace informs the writer that it is employed by the Patháns of Southern Afghánistán for making food utensils, handles to tools, ploughs, &c. TIMBER. 537

FODDER. Leaves.

Fodder.—The LEAVES are used as fodder for cattle (*Stewart*).

Lonicera rupicola, *H. f. et T.; Fl. Br. Ind., III., 13.*

References.—*Duthie, Note on Trees and Shrubs of N.-E. Kumáon, in Indian Forester, XI., 3.*

Habitat.—A small rigid shrub met with in Tibet, the north of Sikkim and Kumáon.

DOMESTIC.

Domestic, &c.—Mr. Duthie writes, "Plentiful in Bijáns, forming near Kutti magnificent hedges between cultivated fields."

LOPHOPETALUM, *Wight; Gen. Pl., I., 362.*

Lophopetalum Wallichii, *Kurz; Fl. Br. Ind., I., 615;* CELASTRINEÆ.

Vern.—*Mondaing, múndain, konazo-ta-lú,* BURM.; *Toung-hmayo,* AND.

References.—*Kurz, For. Fl. Burm., I., 255; in Jour. As. Soc. Beng., 1872, pt. II., 299; Gamble, Man. Timb., 86; Indian Forester, VIII., 416.*

MEDICINE. Bark. Root. Fruit.

Habitat.—A large glabrous tree, common in the open and more especially in the *Eng* forests all over Pegu and Martaban, down to Tenasserim (*Kurz*).

Medicine.—According to **Major Ford** the BARK, ROOT, and FRUIT are used in the Andaman Islands as a febrifuge.

TIMBER.

Structure of the Wood.—"Pale, turning pale-brown, finely and rather loose-grained, hard, rather light, the annual rings very narrow, the heart-wood brown. Recommended for furniture" (*Kurz*). **Major Ford** states that it is used in the Andamans for making writing-boards.

[*Ill., 178.*

L. Wightianum, *Arn.; Fl. Br. Ind., I., 615; Wight, Ic., t. 162;*

Vern.—*Balpalé,* KAN.

References.—*Gamble, Man. Timb., 86; Bedd., Fl. Sylv., t. 145; Anal. Gen., lxv.; Dals. & Gibs., Bomb. Fl., 48; Lisboa, Useful Pl. Bomb., 49; Gazetteer:—Bomb., XV., 430; Balfour, Cyclop., II., 740.*

Habitat.—A large evergreen tree of the Western Coast from the Konkan to Cape Comorin.

TIMBER.

Structure of the Wood.—Reddish-grey, moderately hard, close-grained, weight 28 to 29lb per cubic foot (*Gamble*). It is much esteemed by the natives of South Kanara, where it is used for house-building.

Loquat.—The fruit of Eriobotrya japonica, *Lindl.;* Vol. III., 257.

LORANTHUS, *Linn.; Gen. Pl., III., 207.*

A genus of parasitic evergreen shrubs, which comprises about 350 species, of which 58 are known to be natives of India. Several attack and severely injure certain trees. The majority of the species are called *Pand* in Hindustani, *Ajerú* in Nepalese, *Badanike* in Telegu, and *Khyee-poung* in Burmese.

[*t. 302;* LORANTHACEÆ.

Loranthus longiflorus, *Desr.; Fl. Br. Ind., V., 214; Wight, Ic.,*

Syn.—L. BICOLOR, *Roxb.;* L. KŒNIGIANUS, *Agardh.;* L. WIGHTIANUS, *Wall.;* L. IMBRICATUS and L. LINEATUS, *Edgew.*

Var.—falcata, *Kurz;* L. FALCATUS, *Linn.;* L. WIGHTIANUS, *Wall (in part).*

Var.—amplexifolia, *Thw.;* L. AMPLEXIFOLIUS, *DC.;* L. AMPLEXICAULIS, *Wall.*

Var.—pubescens.

Vern.—*Bándá,* HIND.; *Bura-manda, ? bara-manda,* BENG.; *Banda,* SANTAL; *Ajeru,* NEPAL; *Prústi,* LEPCHA; *Patha,* BANDA; *Kaurak,* BHIL.; *Panda, amút, parand, pand, banda,* PB.; *Bánda,* C. P.; *Vánda,* MAR.; *Vando,* GUZ.; *Velinga, wadinika, velaga badanika, badanike, wajn, ippa wajna,* TEL.; *Khyee-paung,* BURM.; *Vánda, vanna, vrikshadani, vrikshabhaksha, vrikshanúha,* SANS.

L. 272 549

A Destructive Parasite. (*J. Murray.*) **LUCULIA gratissima.**

References.—*Roxb., Fl. Ind., Ed. C.B.C., 184, 301; Brandis, For. Fl., 397; Kurz, For. Fl. Burm., II., 321, 322; Gamble, Man. Timb., 320; Thwaites, En. Ceylon Pl., 134; Grah., Cat. Bomb. Pl., 86; Dalz. & Gibs., Bomb. Fl., 110; Stewart, Pb. Pl., 112; Elliot, Flora Andhrica, 19, 188, 190; DC. Prodr., IV., 304; Campbell, Ec. Prod., Chutia Nagpur, No. 9810; Atkinson, Him. Dist., 316; McCann, Dyes and Tans, Beng., 160, 161, 166; For. Ad. Rep. Ch. Nagpur, 1885, 33; Gazetteers:—Bombay, XV., 442; N.-W. P., IV., lxxvii.; Ind. Forester, I., 300, 301; VI., 238; VII., 180; VIII., 127, 370, 404; X., 309, 325; XII., App., 20.*

Habitat.—A common shrub of the Temperate and Tropical Himálaya, at altitudes from 3,000 to 7,500 feet, extending from Jamu to Bhután, also found in the Gangetic Plains from Oudh eastwards to Assam, and southwards to Travancore, Ceylon, and Malacca. The varieties **falcata**, *Kurz.*, and **pubescens**, are confined to Western India and Ceylon.

The plant occurs as a parasite principally on trees of the following genera—**Acacia, Bassia, Bauhinia, Buchanania, Diospyros, Ficus, Mallotus, Mangifera, Melia, Morus, Prunus, Pyrus, Quercus,** and **Rottlera,** but may also be found on others. Like other members of the genus its seeds are surrounded by a viscid substance which passes uninjured through the intestines of birds, and enables it to obtain a firm attachment to a branch on which it may happen to be dropped. **Dr. Bidie,** commenting on the ravages caused by this parasite in the Nilghiri plantations, on the Apricot, Pear, Peach, and Australian Black-wood (**Acacia melanoxylon,** *R. Br.*), writes: "One or more large branches gets so covered with **Loranthus** that the whole, or nearly the whole, of the sap goes to the parasites, and thus the affected branches die of starvation down to the trunk. Branch after branch perishes in this way, and at length the tree, bereft of its foliage, and robbed of its sap, dies down to the root." It is to be regretted that there is apparently no means of getting rid of these destructive parasites;—excision is said to be useless; indeed, in the report from which the above passage is quoted, **Dr. Bidie** recommended discontinuing the plantations of **Acacia melanoxylon,** because the parasite rendered the timber worthless, save for firewood, and no means could be found of arresting its ravages.

Tan.—The **wood,** prepared as follows, is largely used as a finishing tan-stuff in order to render leather soft:—The leaves are stripped from the shrub, and the sticks, laid together on a hide or mat, are bruised by two or three persons beating them with the *musal* or *gamal* (an iron rimmed wooden pestle used for pounding grain in an *úlkey*). After the skin has been subjected to the action of various tanning materials, and the process of preservation is complete, it is roughly cleaned, sewed up into the form of a bag, and hung upon a tripod. The bruised wood is then placed inside, and the skin is filled with water. It is allowed to remain in this state for a couple of days, and the process is then completed by rubbing one side or other with *khari* salt (*McCann*). TAN. Wood. 550

Domestic, &c.—According to **Birdwood** the **BARK** of **var. falcata** is used in Kanara as a substitute for betel-nut. DOMESTIC. Bark. 551

Lotus, see **Nymphæa pubescens,** *Willd.*

Loxa bark, see **Cinchona officinalis,** *Hook.*; Vol. II., 300.

Lucerne, see **Medicago sativa,** *Linn.*; p. .

LUCULIA, *Sweet; Gen. Pl., II., 43.*

Luculia gratissima, *Sweet; Fl. Br. Ind., III., 36;* **RUBIACEÆ.** 552

Syn.—**CINCHONA GRATISSIMA,** *Wall.*; **MUSSÆNDA LUCULIA,** *Ham.*

Vern.—*Dowari,* **NEP.**; *Simbrangrip,* **LEPCHA.**

References.—*Kurz, For. Fl. Burm., II., 71; Gamble, Man. Timb., 218; List of Trees &c., of Darjeeling, 47.*

L. 552

LUFFA acutangula. — An Oil-yielding plant.

Habitat.—A spreading shrub of the Temperate Himálaya from Nepál to Bhotán, at altitudes from 4,000 to 6,000 feet, distributed to the Ava Hills.

DYE. Leaves. 553 575

Dye.—Gamble states that the LEAVES are used in dyeing, alone or mixed with those of Hedyotis capitellata, *Wall.*

DOMESTIC. Flowers. 554 576 555 577

Domestic.—The handsome, pink, long-tubed flowers are much worn by the Paharias and Lepchas (*Gamble*).

LUFFA, *Linn.; Gen. Pl., I., 823.*

A genus of climbing plants, which comprises ten species, natives of the warmer regions of the Old World, and one indigenous in America. Of these four or five are truly wild in India.

556 578 **Luffa acutangula**, *Roxb.; Fl. Br. Ind., II., 615;* CUCURBITACEÆ.

Syn.—CUCUMIS ACUTANGULUS, *Wall. var.* amara may, for convenience of description, be considered separately.

Vern.—*Torai, jinga, turi,* HIND.; *Jhingá, jinga,* BENG.; *Janhi,* URIYA; *Puror jhinga,* SANTAL; *Ramtoroi,* NEPAL; *Puichenggah,* MAL. (S.P.); *Káli-taroi, satpatiya,* BUNDEL.; *Taroi, káh taroi, torai, satpatiya, jajinga,* N.-W. P.; *Torié,* KUMAON; *Gharár gundoli,* KANGRA; *Káli tori, turái, jhinga,* PB.; *Túri,* SIND; *Dorka,* C. P.; *Turai, sirola, gonsali, jinga,* BOMB.; *Shirola.* MAR.; *Turin, ghisoda,* GUZ.; *Turai,* DEC.; *Pikunkai,* TAM.; *Burkai, bira-káya,* TEL.; *Hirékáyi,* KAN.; *Djinji,* MALAY.; *Tha-bwot-kha-wai, thapwot,* BURM.; *Jhingáka,* SANS.; *Khiyár,* PERS.

References.—*Roxb., Fl. Ind., Ed. C.B.C., 698; Voigt, Hort. Sub. Cal., 56; Stewart, Pb. Pl., 98; DC., Origin Cult. Pl., 271; Mason, Burma and its People, 471, 747; Elliot, Flora Andh., 27; O'Shaughnessy, Beng. Dispens., 351; U. C. Dutt, Mat. Med. Hind., 301; S. Arjun, Bomb. Drugs, 59, 203; Murray, Pl. and Drugs, Sind, 40; Baden Powell, Pb. Pr., 348; Atkinson, Him. Dist., 700; Econ. Prod. N.-W. P., V., 6; Drury, U. Pl., 382; Duthie & Fuller, Field and Garden Crops, Pt. II., 60, Pl. lxii.; Lisboa, U. Pl. Bomb., 158; Birdwood, Bomb. Pr., 158; Royle, Ill. Him. Bot., 219; Cooke, Oils and Oilseeds, 55; Stocks, Rep. on Sind; Agri.-Hort. Soc. of Ind., Trans., IV., 104; VII., 64, 66; Journ. (Old Series), IV., 202; Ind. Forester, IX., 201; Gazetteers:—Orissa, II., 180, App. VI.; Bombay, VIII., 183; N.-W. P., I., 81; IV., lxxii; Settle. Repts.:—Chánda, Kumáon, App. 33, 82; Kángra, 25, 28.*

Habitat.—Met with in North-West India, Sikkim, Assam, and Eastern Bengal; distributed to Ceylon and Malaya; it is also cultivated in most parts of India.

CULTIVATION.—The fruit, for which the plant is grown, is produced during the rainy season. Sowings should be made from March to the beginning of June. Rich soil should, if possible, be selected, and the seed sown in lines 5 feet apart. When the young plants are about 4 inches high, supports should be given for them to climb on. Until the rains begin the first sowings should be regularly watered. Two sowings—one early, the other late—will keep up a supply from July till October (*Ind. Forest., IX., 201*). No information of a trustworthy nature can be given regarding the area occupied by the crop.

OIL. Seeds. 557 579

Oil.—The SEEDS of this species like those of most other Cucurbitaceous plants yield an oil. No definite information exists regarding the quantity obtainable, nature, or properties of this oil, but it is presumably similar to the more important commercial oils obtained from the melon, &c.

MEDICINE. Seeds. 558 580 Leaves. 559 581 Root. 560 582

Medicine.—The SEEDS possess emetic and purgative properties, but to a much less marked degree than those of the variety amara. Dr. Emerson states that the LEAVES are used locally in splenitis, hæmorrhoids, and leprosy. Aitchison writes, "the ROOT is used in medicine."

SPECIAL OPINION.—§ "The juice of the fresh leaves is dropped into the eyes of children in granular conjunctivitis, also to prevent the lids

A substitute for Ipecacuanha. (*F. Murray.*) LUFFA acutangula.

adhering at night from excessive meibomian secretion" (*Honorary Surgeon P. Kinsley, Chicacole, Ganjam, Madras*).

FOOD. Fruit. 561

Food.—The FRUIT is highly esteemed by Natives, and is much eaten by them, either in curries or dressed with clarified butter. When half grown it is one of the best indigenous Indian vegetables, and when peeled, boiled, and dressed with butter, pepper, and salt is very palatable. When fully developed it is about a foot long, but if allowed to grow longer than 4 inches it rapidly deteriorates in quality, and becomes useless for the table.

DOMESTIC. Fruit. 562 563

Domestic.—Dr. Stewart, Cuttack, reports that the fibrous coat of the mature CAPSULE of this and the succeeding variety, forms a cheap and efficient flesh brush.

Luffa acutangula, *Roxb.; var.* amara; *Fl. Br. Ind., II., 615.*

Syn.—L. AMARA, *Roxb.*; L. PLUKENETIANA, *DC.*; MOMORDICA TUBIFLORA, *Wall.*

Vern.—*Karvi-turi, karwitarui,* HIND.; *Ghoshá-latá, tito-jhingá, titotorai, tito-dhundul,* BENG.; *Kerula** (Atkins.), N.-W. P.; *Karvi-turái,* DEC.; *Kadú-sirola, kadú-dorka,* BOMB.; *Kadú-dodaká,* MAR.; *Pé-pirkkam,* TAM.; *Adavi-bira, chédu-bira, verri-bira, sendu-bir-kai,* TEL.; *Koshátaki,* SANS.

References.—*Roxb., Fl. Ind., Ed. C.B.C., 699; Voigt, Hort. Sub. Cal., 57; Elliot, Flora Andhr., 10, 35, 37; U. C. Dutt, Mat. Med. Hind., 305; Dymock, Mat. Med. W. Ind., 2nd Ed., 342; S. Arjun, Bomb. Drugs, 59; Atkinson, Ec. Prod., N.-W. P., Pt. V., 6; Drury, U. Pl., 282; Lisboa, U. Pl. Bomb., 158; Balfour, Cyclop., II., 746; Agri.-Hort. Soc. of Ind., Trans., II., 110; VII., 64, 66; Jour. (Old Series), 309.*

Habitat.—Met with all over India, especially on the western side.

MEDICINE. Fruit. 564 Juice. 565 Seeds. 566 Leaves. 567

Medicine.—Roxburgh appears to have been the first European writer to notice the medicinal properties of this gourd. He writes: "Every part of the plant is remarkably bitter, the FRUIT is violently cathartic and emetic. The JUICE of the roasted young fruit is applied to the temples by Natives to cure headache. The ripe SEEDS, either in infusion or substance, are used by them to vomit and purge." In the *Pharmacopœia of India* the plant is described as bitter, tonic, and diuretic, but, from the vernacular names there given, *viz.*, *kerúla* and *bindál*, it appears that the gourd meant may in reality be Momordica Charantia (*See note to vernacular terms*). Dymock writes: "The LEAVES are bitter, the fruit less so; the former in Bombay are used as an external application to sores in cattle. In dog-bite the pulp of the fruit is given with water; it causes vomiting and purging. The juice is applied in different kinds of bites, and the dried fruit is used as a snuff in jaundice. The root with equal parts of *jasúnd* root" (Hibiscus rosa-sinensis, *Linn.*) "and Hemidesmus is given with milk, cummin and sugar in gonorrhœa." From the following interesting note by Moodeen Sheriff it would appear that the seeds, if carefully prepared and administered, are of considerable value as a specific for dysentery. Should this prove to be correct, the drug would be a cheap, easily obtained, and most valuable substitute for Ipecacuanha. In any case, the method below recommended seems worthy of attention and careful trial.

SPECIAL OPINIONS.—§ "The mature and dry seeds of both Luffa acutangula and L. amara are emetics, but the action of the former is very irregular and uncertain. In some cases, they act in twenty to thirty-five grain doses pretty satisfactorily; but in others, they either do not act at all, or act violently and continue to produce vomiting for many hours.

* Moodeen Sheriff remarks: "*Karólá* or *Kerula* is the name assigned to this plant in some books, but is correctly the name of Momordica Charantia, both in Hindustani and Bengali."

L. 567

LUFFA ægyptiaca. — **A substitute for Ipecacuanha.**

MEDICINE.

On the other hand, the action of the seeds of L. amara is very sure, safe, and efficient in the same or somewhat smaller doses. The Hindu practitioners are aware that the fruit of L. amara is emetic, but they do not know what particular part of it possesses that property They use it, seeds and all, in infusion. One entire fruit, generally of middle size, is bruised and infused in some cold water at night, and the liquid is strained through and administered in the morning. The action of this draught is generally very irregular, uncertain, and often accompanied by griping, and is, therefore, very unsatisfactory. I have used the different parts of the fruit of this plant separately, and found the emetic property to reside in the kernel or cotyledons of the seeds. The seeds are dark-brown, oblong or oval, flat, rough with minute elevated dots, margin turned, and only distinct at the base. The length of the seeds varies from one-third to half an inch, and the breadth, from three to five lines; the kernel is albuminous, greenish-white, very bitter and oily. The kernel of the seeds is the best, and forms the only vegetable emetic in India which is equal to Ipecacuanha in the same quantity. In smaller doses, it is expectorant and also demulcent, owing to its containing albumen and oil. In addition to the above properties, it has a great control over dysentery. I have used this drug and also Ipecacuanha, separately, in several cases, in the same manner and doses, and found it to be at least quite equal to the latter. The dose of the kernel as an emetic is from twenty to thirty grains; as a nauseant, from eleven to fifteen grains; and as demulcent and expectorant from five to ten grains. When the kernel is rubbed and mixed with water it forms a greenish-white emulsion, which is the only form in which I have yet used it" (*Honorary Surgeon Moodeen Sheriff, Khan Bahadur, G. M. M. C., Triplicane, Madras*).

DOMESTIC. Rind.

Domestic.—The dried fibrous RIND is used by the natives in certain parts of the country as a brush for sizing paper (*Agri.-Hort. Soc. of India, Trans., II., 110*).

568 569

Luffa ægyptiaca, *Mill.*; *Fl. Br. Ind. II., 614*; *Wight, Ic., t. 499.*

Syn.—LUFFA PENTANDRA, *Roxb.*; L. RACEMOSA, *Roxb.*; L. CLAVATA, *Roxb.*; L. ACUTANGULA, *W. & A.* (*not of Roxb.*); L. CYLINDRICA, *Rœm.*; L. PETOLA *and* CATTU-PICCINA, *Seringe*; L. PARVALA, *Wall.*; L. GOSA, HEDERACEA, *and* SATPATIA, *Wall.*; BRYONIA CHEIROPHYLLA, *Wall.*; MOMORDICA LUFFA, *Linn.*

Vern.—*Ghiá-tarui, purula,* HIND.; *Dún-dúl, dhundul,* BENG.; *Bhol, bhatkerela, bhatkakrel,* ASSAM; *Palo,* NEPAL; *Ghiya taroi, ghiya tori,* N.-W. P.; *Tarod, ghiya taroi, turai, dhandal,* KUMAON; *Ghía tori, ghi turái, ghi gandoli,* PB.; *Turi, liasada,* SIND; *Dilpasand, tel doaka,* C. P.; *Ghosáli, parosi, parula, turi, gonsali,* BOMB.; *Turia,* GUZ.; *Gutti bira, néti bira, núne bira,* TEL.; *Tha-bwot, tha-pwot-kha,* BURM.; *Neyang-natta-colú,* SING.; *Rájakoshátaki, dirghapatolika,* SANS.; *Luff,* ARAB.; *Khujar,* PERS.

References.—*Roxb., Fl. Ind., Ed. C.B.C., 698, 699; Thwaites, En. Ceylon Pl., 126; Stewart, Pb. Pl., 98; DC., Origin Cult. Pl., 269; Elliot, Fl. Andhr., 67, 133, 138; Mason, Burma and Its People, 470, 747; U. C. Dutt. Mat. Med. Hind., 297, 315; Murray, Pl. and Drugs, Sind, 40; Med. Top. Ajmir, 149; Atkinson, Him. Dist., 310, 700; Ec. Prod. N.-W. P., V., 6; Drury, U. Pl., 282; Duthie & Fuller, Field and Garden Crops, II., 61, pl. lxiii.; Lisboa, U. Pl. Bomb., 158; Cooke, Oils and Oilseeds, 56; Balfour, Cyclop., II., 747; Kew Off. Guide to the Mus. of Ec. Bot., 71; Agri-Hort. Soc. of Ind., Trans., VII., 64; Jour. (Old Series), IV., 202; IX., Sel., 58; Indian Forester, IX., 201; Gazetteers:—Bombay, V., 26; N.-W. P., IV., lxxii.; Settlement Reports:—Chanda (C. P.), 82; N.-W. P., App., 33; Kangra (Pb.), 25, 28.*

Habitat.—A native of India, cultivated or naturalised in most hot countries of the world. In India it is common everywhere, and is often cultivated, especially in the plains.

Luffa. (*J. Murray.*) LUMNITZERA racemosa.

CULTIVATION.—The seasons of sowing, of ripening of the fruit, and the method pursued in its cultivation are exactly similar to those of **L. acutangula**, and need not be again detailed. No returns are available of the area under the crop, with the exception of the incomplete figures given by **Messrs. Duthie & Fuller.** These writers state that during the rains of 1881, 256 acres was returned as the area in Allahabad, 199 in Meerut, 104 in Budaon, and smaller figures varying from 30 to 65 in Cawnpore, Bijnor, Pilibhit, Bulandshahr, Muttra, and Jalaun. The total area for all these districts was 849 acres. CULTIVATION.

Oil.—An oil is obtained from the SEEDS, probably similar to that of other CUCURBITACEÆ. OIL. Seeds. 570

Medicine.—The SEEDS are said to be emetic and cathartic like those of **L. acutangula.** MEDICINE. Seeds.

Food.—The FRUIT, which is smaller than that of **L. acutangula**, is also edible, and is similarly used in curries, &c., by the natives. FOOD. Fruit. 571

Domestic.—The DRY FRUIT, which is filled with an interwoven network of fibre, is used as a flesh-brush in Turkish Baths. DOMESTIC. Fruit. 572

Luffa echinata, *Roxb.; Fl. Br. Ind., II., 615.*

573

Syn.—L. BINDAAL, *Roxb.*

Vern.—*Jangthori*, SIND; *Kukar-wel*, BOMB.; seeds=*Wa-upla-bij*, GUZ.; seeds=*Deodágri*, MAR.; *Pani bira*, TEL. 574

References.—*Roxb., Fl. Ind., Ed. C.B.C., 699; Kurz, in Jour. As. Soc., 1877, II., 101; Dalz. & Gibs., Bomb. Fl., 102; S. Arjun, Bomb. Drugs, 59; Elliot, Fl. Andhr., 143; Dymock, Mat. Med. W. Ind., 2nd Ed., 343; Murray, Pl. and Drugs of Sind, 40.*

Habitat.—Native of Gujarat, Sind, Purneah, and Dacca, distributed to Tropical Africa.

Medicine.—**O'Shaughnessy**, writing in 1841, mentions that the FRUIT is considered in North India to be a powerful remedy for dropsy. **Arjun** states that the fruit has purgative properties. **Dymock** writes: "I have not met with any notice of the medicinal use of this plant in European works on the Materia Medica of India." (The writer has evidently inadvertently overlooked the observations of **O'Shaughnessy** and **Arjun.**) "**Roxburgh** describes its botanical characters. In the Bombay Presidency it is found mostly in Gujarat, where it has a reputation among the Hindus on account of the bitter properties of the fruit, and is an ingredient in their compound decoctions. In the Konkan a few grains of the bitter fibrous contents of the fruit are given in infusion for snake-bite, and in cholera after each stool. In putrid fevers the infusion is applied to the whole body, and in jaundice it is applied to the head and also given internally; the infusion has also a reputation as a remedy for colic. The dried vine with the ripe fruit attached is brought to Bombay for sale along with other herbs from the province of Gujarat." MEDICINE. Fruit. 575

LUMNITZERA, *Willd.; Gen. Pl., I., 687.*

Lumnitzera racemosa, *Willd.; Fl. Br. Ind., II., 452;* COMBRETACEÆ. 576

Syn.—PYRRANTHUS ALBUS, *Wall.*; PETALOMA ALTERNIFOLIA, *Roxb.*; BRUGUIERA MADAGASCARENSIS, *DC.*

Vern.—*Kripa, kirpa*, BENG.; *Baireya*, SING.; *Yengyé, hmaing. yin-yé*, BURM.

References.—*Roxb., Fl. Ind., Ed. C.B.C., 361; Brand., For. Fl., 221; Kurz, For. Fl. Burm., I., 468; Beddome, Fl. Sylv., Anal. Gen., Pl., xxi.; Thwaites, En. Ceylon Pl., 103; Gamble, Man. Timb., 178; Mason, Burma and its People, 743; Lisboa, U. Pl. Bomb., 77.*

Habitat.—A small tree occurring on the coasts of India, Ceylon, and the Trans-Gangetic Peninsula, also on the coasts of the Andamans and Nicobars; distributed to Tropical Africa, Malaya, North Australia, and Polynesia.

TIMBER. 577

Structure of the Wood.—Roxburgh writes: "The wood is remarkably strong and durable; it is much used for posts and other parts of the houses of the natives, but its chief consumption about Calcutta is for fuel."

LUPINUS, *Linn.; Gen. Pl., I., 480.*

578 **Lupinus albus**, *Linn.; DC. Prodr., II., 407;* LEGUMINOSÆ.

Syn.—L. SATIVUS, *Gater.*

Vern. *Turmás*, HIND.; *Túrmús*, BENG.; *Túrmus, surmish*, PB.; *Turmus, bakila-i-misri*, PERS.

References.—*DC., Origin of Cultivated Pl., 325; Honigberger, Thirty-five Years in the East, II., 302; Dymock, Mat. Med. W. Ind., 2nd Ed., 292; Irvine, Mat. Med. Patna, 114; S. Arjun, Bomb. Drugs, 42; Year Book Pharm., 1874, 624; Baden Powell, Pb. Prod., 342; Church, Food Grains of Ind., 123; Smith, Dic., 234; Agri.-Hort. Soc. of Ind., Jour. (Old Series), II., (Sel.), 173, 174; Quarterly Jour. of Agric., IX., 317.*

Habitat.—An annual herb, native of the Levant, extensively cultivated in Southern Europe, Egypt, and Asia south of the Caucasus; said by Church to be also cultivated in some parts of India.

MEDICINE. Seeds. 579

Medicine.—The SEEDS, called by the above vernacular names, are imported from Egypt and are used by the *Hakims* as a deobstruent, alterative, and anthelmintic. Honigberger states that in the Panjáb they were used in cases of "internal heat" and leprosy; Irvine describes them as carminative. The Persian name *turmus* is said by Dymock to be derived from the Greek θερμος, or the Coptic θαρμος, seeds used by the Greeks to counteract the effects of drink. In the south of Europe, at the present day, they are considered anthelmintic, and are also ground and boiled to form poultices. The active principle is an alkaloid called *Lupinin*, which has a very bitter taste and is poisonous to frogs, but apparently is not deleterious to man, even if given in rather large doses. It is dissipated by heat.

FOOD and FODDER. Seeds. 580

Food and Fodder.—The lupin is largely cultivated in Southern Europe for the sake of its highly nutritious SEEDS, which are boiled and used as food. Church gives the following as the composition of 100 parts: water 12·5, albumenoids 31·7, starch 33·7, oil 5, fibre 13·5, and ash 3·6.

The same author states that the high amount of fibre renders a good deal of the albumenoids and oil unavailable for digestion. The seeds are also a good food for cattle.

DOMESTIC. Seeds. 581 Plant. 582

Domestic, Agricultural, &c.—A preparation of the SEEDS is employed in Tuscany as a cosmetic. The PLANT is a very valuable green manure and has been cultivated for this purpose from the earliest times in the south of Europe. The yellow lupin (L. luteus) is grown in Germany and some parts of England for the same purpose. The crop acts as a valuable leguminous rotation, improving the soil by the depth to which its roots penetrate.

Lupulus, see Humulus Lupulus, *Linn.*; Vol. IV., 302.

LYCHNIS, *Linn.; Gen. Pl., I., 147.*

583 **Lychnis indica**, *Benth.; Fl. Br. Ind., I., 225;* CARYOPHYLLEÆ.

Var.—indica proper, SILENE INDICA, *Roxb.*; MELANDRYUM INDICUM. *var.* GENUINUM, *Rohrb.*

Var.—fimbriata, *Wall.*; L. ERIOSTEMON, *Wall.*; MELANDRYUM INDICUM, *var.* FIMBRIATUM, *Rohrb.*

A poisonous Lycium. (*J. Murray.*) **LYCOPERDON gemmatum.**

Habitat.—A tall, spreading, weak herb, of the Temperate Himálaya from Nepál to Marri, at altitudes of 5,500 to 10,000 feet.

Domestic.—Aitchison states that in Lahoul the ROOT and LEAVES are used for soap (*Stewart, Pb. Pl., 20*).

DOMESTIC. Root. 584 Leaves. 585 586

LYCIUM, *Linn.; Gen. Pl., II., 900.*

A genus of spinous shrubs, which comprises about 40 species, all natives of temperate and sub-tropical regions, especially of South Africa and South America; of these 3 are indigenous in India.

Lycium barbarum, *Linn.; Fl. Br. Ind., IV., 241;* SOLANACEÆ. 587

Syn.—L. EDGEWORTHII, *Dunal.;* L. DEPRESSUM *and* FOLIOSUM, *Stocks.*

Vern.—*Koh-tor,* BALUCH; *Barghouna, karghauna,* PUSHTU.

References.—*Aitchison, Bot. Afg. Del. Com., 91; Murray, Pl. and Drugs of Sind, 159; Smith, Dic., 57; Indian Forester, XIV., 362; Notes by Mr. Lace on Afgh. Pl.*

Habitat.—A spiny shrub of the Panjáb and Sind, distributed to Western Asia. The only point of interest connected with this plant, is, that during the Afghán Delimitation Commission many camels were supposed to have died at Omar-sha in consequence of eating the shrub when in fruit. This fact is the more curious, since, though belonging to the Night-shade order, neither this nor any other species of **Lycium** had been previously supposed to possess poisonous properties.

Poison. 588

L. europæum, *Linn.; Fl. Br. Ind., IV., 240; Wight, Ic., t. 1403.* 589

Syn.—LYCIUM INDICUM, *Wight.;* L. MEDITERRANEUM, *Dunal.;* L. SÆVUM, ORIENTALE, *and* PERSICUM, *Miers.;* L. INTRICATUM, *Boiss.;* L. ARABICUM, *Schweinf.*

Vern.—*Achmehudi,* MERWARA; *Gangro, ganger,* SIND; *Kangú, kúngú, kangi, ganger, mrál, chirchitta,* PB.

References.—*Brandis, For. Fl., 345; Gamble, Man. Timb., 273; Stewart, Pb. Pl., 156; Murray, Pl. & Drugs of Sind, 158; Baden Powell, Pb Prod., 584; Indian Forester, XII., App., 18;* Gazetteers:—*Bomb., V., 27; N.-W. P., IV., lxxv.*

Habitat.—A small, thorny shrub, not uncommon in the drier tracts of the Panjáb plains from Delhi west to the Súliman Range, found also in Sind, Gujerat, and the Deccan.

Medicine.—"The BERRIES are used medicinally as an aphrodisiac" (*Stewart*).

MEDICINE. Berries. 590

Food and Fodder.—The BERRIES are eaten by Natives in certain parts of the Panjáb. The PLANT is browsed by camels, goats, &c (*Stewart*).

FOOD and FODDER. Berries. 591 Plant. 592

Domestic.—The BRANCHES are used for fuel, and are made into wattled frames for the wall of huts (*Stewart*).

DOMESTIC. Branches. 593 594

L. ruthenicum, *Murray; Fl. Br. Ind., IV., 241.*

Syn.—L. TATARICUM, *Pall.;* L. ARMATUM, *Griff.;* L. GLAUCUM, *Miers.*

Vern.—*Khichar, khitsar, kitserma,* LADAK.

References.—*Griff., Ic. Pl. Asiat., t. 415; Brandis, For. Fl., 346; Stewart, Pb. Pl., 157; Aitch., Bot. Afgh. Del. Comm., 91.*

Habitat.—A small, thorny shrub, of North Kashmír and Western Tibet; distributed to Afghánistán, Persia, and Central Asia.

Food.—The FRUIT, which is of the shape and size of a large pea, and deep reddish-purple when ripe, is eaten by Natives, but though sweet, is mawkish and flavourless.

FOOD. Fruit. 595

Lycoperdon gemmatum, *Batsch;* THE PUFF BALL; *Kúṇ'a,* PB.; FUNGI; see Vol. III., 455.

LYCOPERSICUM, *Mill.; Gen. Pl., II., 888.*

596 [illegible]

Lycopersicum esculentum, *Mill.; Fl. Br. Ind., IV., 237;* SOLANACEÆ.
THE TOMATO OR LOVE-APPLE.

Syn.—L. CERASIFORME, *Dunal.;* SOLANUM LYCOPERSICUM, *Linn.;* S. HUMBOLDTII, *Willd.;* S. PSEUDOLYCOPERSICUM, *Jacq.*

Vern.—*Gur-begun, timoti, tamati,* HIND., BENG.; *Belati bengana,* ASSAM; *Wiláyati baigan,* N.-W. P.; *Bhatte,* PB.; *Wal-wangi,* BOMB.; *Vel-vángi, tamáte,* MAR.; *Viláyti vengan,* GUZ.; *Simie-takalie-palam,* TAM.; *Chhapar-badne,* KAN.; *Tamátie,* MALAY.; *Ka-yam-my-pong,* BURM.; *Maha-rata-tamátie,* SING.

References.—*Roxb., Fl. Ind., Ed. C.B.C., 190; DC., Origin Cult. Pl., 290; Mason, Burma and Its People, 471, 798; Year Book Pharm., 1873, 85; Atkinson, Him. Dist., 703; Econ. Prod., N.-W. P., V., 13, 19; Lisboa, U. Pl. Bomb., 167; Birdwood, Bomb. Pr., 170; Balfour, Cyclop., II., 752; Smith, Dic., 414; Agri.-Hort. Soc. of Ind.;—Transactions, III., 10, 197 (Pro.), 227, 239, 284; VI. (Pro.), 36; VII. (Pro.), 116; Journal (Old Series), IX. (Sel.), 55; X., 91; (New Series), IV., 38; V., 35, 44; Gazetteers:—Mysore and Coorg, I., 63; Bombay, VII., 40; Settle. Repts.:—Chanda, 82; Simla, 41.*

Habitat.—A trailing plant introduced from South America, and cultivated in many parts of India for its large red, or sometimes yellow, fruit. It is also found in many localities as an escape from cultivation. In the plains the seed is sown in autumn, and the fruit ripens during winter and spring. In the hills the plant grows more luxuriantly; and bears fruit throughout the summer and autumn months.

FOOD. Fruit.

Food.—Natives are beginning to appreciate the FRUIT, but the plant is still chiefly cultivated for the European population. Bengalis and Burmans use it in their sour curries.

LYCOPODIUM, *Linn.; Baillon, Bot. Med. Crypt., 28.*

LYCOPODIACEÆ.

598 [illegible]

Lycopodium clavatum, *Linn.; Bent. & Trim., Med. Pl., 299;*
THE CLUB-MOSS.

Syn.—L. INFLEXUM, *Sw.*

References.—*Baillon, Bot. Med. Crypt., 30; Flückiger and Hanb., Pharmacog., 731; Smith, Dic., 121; Balfour, Cyclop., II., 752.*

Habitat.—This plant, the common club-moss, is almost cosmopolitan, being found in the temperate and colder regions of both hemispheres. It occurs in hilly districts throughout Europe, Northern Asia, and North America, extending to within the Arctic circle and to the Himálaya. It also grows in Australia, the Cape of Good Hope, the Falkland Islands, Madagascar, Java, Japan, and tropical America.

MEDICINE. Spores.

Medicine.—The minute SPORES, shaken out of the mature sporangia or capsules, form a light yellow powder which has been used [illegible] since the seventeenth century. This powder is, however, now [illegible]any and some as possessing any medicinal virtue, and is employed e[illegible]cts as a valuable dusting excoriated surfaces and for placing in pill boxes to which its roots mutual adhesion of pills (*Pharmacographia*). In former times

Herb.

the HERB were administered internally in retention of urine, p[illegible] and calculous complaints. Of late years it has been again [illegible] notice for similar diseases, and also as a remedy for dyspepsi[illegible] tion with flatulence, hepatic congestion, and pustular skin erupti[illegible]

[illegible]LLEÆ.

CHEMICAL COMPOSITION.—The SPORES contain 47 per cent. o[illegible] INDICUM. liquid, fixed oil, which does not solidify even at 15°C. By distilling [illegible] dium with or without an alkali, Stenhouse obtained volatile base[illegible]UM INDI- small proportion (*Pharmacographia*). Certain allied species cont[illegible]

a large amount of alumina in their ash, that they are employed as mordants in dyeing (*Baillon*).

Domestic, &c.—The chief use of **Lycopodium** is in the manufacture of fire-works and for producing artificial lightning at theatres. DOMESTIC. 603 601

LYCOPUS, *Tourn.; Gen. Pl., II., 1183.*

Lycopus europæus, *Linn.; Fl. Br. Ind., IV., 648;* LABIATÆ. 604 602

THE GIPSY-WORT.

Var.—exaltata,—L EXALTATUS, *Linn.*

Vern.—*Gandamgúndú*, bazár plant=*jalnim*, KASHMIR.

References.—*Stewart, Pb. Pl., 168; Gazetteer, N.-W. P., IV., lxxvi.*

Habitat.—A small, perennial herb found in marshy ground on the Western Himálaya, between altitudes of 1,000 and 6,000 feet; distributed to Europe, West, North, and Central Asia.

Medicine.—Part of the PLANT is sold in bazárs in Northern India, under the above name, as a cooling drug (*Stewart*). Surgeon-Major Calthrop reports that the LEAVES are used externally as a poultice to cleanse foul wounds. MEDICINE Plant. 605 603 Leaves. 606 604

LYSIMACHIA, *Linn.; Gen. Pl., II., 635.*

Lysimachia candida, *Lindl.; Linn. Soc. Jour., XXV., 48;* PRIMULACEÆ. 607 605

Syn.—L. SAMOLINA, *Hance.*

Habitat.—Found in the valley of Manipur in rice fields, between 2,000 and 3,000 feet in altitude (*Watt*).

Food.—Eaten by the Manipuris as a pot-herb along with fish (*G. Watt*). This fact is of considerable interest, since before Dr. Watt made the observation that this species was regularly used as a vegetable, no member of the PRIMULACEÆ was known to be edible. FOOD. Plant. 608 606

Lytta.—A genus of Coleopterous insects, certain species of which may be employed as substitutes for Cantharides (see Mylabris, p. 309).

MABA nigrescens. — A Useful Timber.

(*G. Watt.*)

MABA, *J. R. & G. Forst.; Gen. Pl., II., 664.*

[*Fl. Br. Ind., III., 551;* EBENACEÆ.

1 **Maba andamanica,** *Kurz; Jour. As. Soc. Beng., 1876, Pt. II., 138;*

References.—*Kurz, For. Fl. Burm., II., 140.*

Habitat.—A shrub, 3 to 5 feet in height; frequently met with in the moister upper mixed forests of the Andaman and Nicobar islands.

TIMBER. Structure of the Wood.—Bluish-grey. Weight 49lb per cubic foot.

2 **M. buxifolia,** *Pers.; Fl. Br. Ind., III., 551.*

3 Roxburgh translates the Tamil name into IRON WOOD.

Syn.—FERREOLA BUXIFOLIA, *Roxb.*; MABA EBENUS, *Wight, Ic., tt. 1228, 1229*; M. NEILGHERRENSIS, *Wight, Ill., t. 148.*

Vern.—*Gua koli, pisina,* URIYA; *Iramballi, eruvalli, humbilli,* TAM.; *Nella-madi, pishina, uti chettu, pisinika,* TEL.; *Mépyoung,* BURM.; *Kalu-kabaraliya* (*Thuvarai, irumpalai,* TAMIL), SING.

References.—*Roxb., Fl. Ind., Ed. C.B.C., 724; Kurz, For. Fl. Burm., ii., 139; Pegu Prel. Rept., 86; Beddome, Fl. Sylv., cxlviii.; Gamble, Man. Timb., 247, xxv.; Trimen, Cat. Ceylon Pl., 51; Mason, Burma and Its People, 543, 782; Sir W. Elliot, Fl. Andh., 153, 187; Drury, U. Pl., 824; Indian Forester:—III., 237; VII., 127; X., 31; XII., 313; Man. Trichinopoly, 78; Gas., Orissa, II., 181; also App. VI.*

Habitat.—A bush or small tree found in the Southern Deccan Peninsula, the Circar Mountains to Orissa, the Malay Peninsula, from Pegu to Malacca and distributed to Ceylon, North Australia, the Philippines, and Tropical Africa and Madagascar.

FOOD. Berries. Food.—It flowers during the hot season, and produces BERRIES which, when ripe, are generally eaten by the natives, and are said to taste well. It is mentioned by Shortt in his list of famine foods of Madras.

4

TIMBER. Structure of the Wood.—Roxburgh says, "the wood is dark-coloured, remarkably hard, and durable It is employed for such uses, when its size will admit, as require the most durable heavy wood." This opinion is also given by Moore in his *Manual of Trichinopoly*, but Gamble remarks that the wood is "greyish white, moderately hard:" "the bush in Orissa," he adds, "is very common on poor soils" Mason speaks of it as a hard, tough, knotty wood which the Tavoyers select for anchors to their large boats. Kurz says, the "wood is dark-coloured, hard, and durable." In a report of the Forests of Ceylon by F. D'A. Vincent, Deputy Conservator of Forests, Madras, this tree is mentioned in a list of the undergrowth of the dry zone where it is known as *tuvere*. It is also alluded to as met with on similar soils in the Upper Godávari and Mudumalai forests.

5

6 **M. nigrescens,** *Dalz.; Fl. Br. Ind., III., 551.*

Vern.—*Kari,* KONKAN; *Kúla jhád,* MAR.; according to Dalzell & Gibson this is also known in Southern Bombay Forests as *Raktúra*, a name, however, which Lisboa remarks is given to several other trees also.

References.—*Dalz. & Gibs., Bomb. Fl., 142; Bomb. Gaz. (Kánara), XV., Pt. I., 72, 437; Useful Pl., Bomb., 95 (incorrectly reduced to Maba buxifolia), 348.*

Habitat.—A small tree of the Western Ghâts from the Konkan to Mysore. Mr. Talbot specially mentions it as occurring near the falls of Gersaffa and elsewhere in North Kánara.

FOOD. Berries. Food.—Mr. Lisboa affirms that the BERRIES are eaten, but he is probably alluding to the more peculiarly South Indian species M. buxifolia, of which the berries are certainly eaten.

7

TIMBER 8 Structure of the Wood.—In the *Konkan Gazetteer* it is stated of this timber that it is small but remarkably hard and strong, and particularly prized for round rafters in native houses.

MACARANGA, *Thouars; Gen. Pl., III., 320.*

[EUPHORBIACEÆ.

Macaranga denticulata, *Müll. Arg.; Fl. Br. Ind., V., 446;* 9

Syn.—MACARANGA GUMMIFLORA, *Muell. Arg.;* MAPPA DENTICULATA, *Blume;* M. GUMMIFLORA, *Miq.;* M. TRUNCATA, *Muell. Arg.;* M. WALLICHII, *Baill;* and M. PANICULATA, *Wall.*

Vern.—*Burua,* CHITTAGONG; *Pawaing,* MAGH.; *Chakro,* GARO; *Jogi, mallata,* NEPAL; *Numro,* LEPCHA; *Toung-kpek-wan, taung-petwan,* BURM. Gamble distinguishes M. gummiflora as *Jogi mallata* in Nepalese and M. denticulata as simply *Mallata.*

References.—*Kurz, For. Fl. Burm., II., 287; Gamble, Man. Timb., 363.*

Habitat.—A small evergreen tree, often gregarious, found in the Sikkim hills, from 3,000 to 6,000 feet, but chiefly on old clearings. Also found in Assam, Khasia hills, Chittagong, and Burma.

Resin.—Mr. J. N. Pickard (of the Forest Department, Burma) reports that this yields a red resin, a fact also alluded to by Kurz; but no mention is made of the properties or uses of the substance. It is probable that the resins obtained from all the species of Macaranga are similar to that described below under M. Roxburghii. RESIN. 10

Structure of the Wood.—A fast growing tree, showing three rings per inch of radius, and attaining a height of 40 feet in ten years. Weight about 22 to 29lb a cubic foot. Gamble says that it is much used for fencing and temporary huts. Kurz remarks that the wood is red-brown, adapted for cabinet work. TIMBER. 11

M. indica, *Wight; Fl. Br. Ind., V., 446; Ic., tt. 1883 & 1949, f. 2.* 12

Syn.—MACARANGA FLEXUOSA, *Wight, Ic., t. 1909, f. iii.;* TREWIA HERNANDIFOLIA, *Roth.*

Vern.—*Boura,* BENG.; *Modula,* ASSAM; *Laikeza,* MICHI; *Lal mallata,* NEPAL; *Chánda,* MAR.

References.—*Kurz, For. Fl. Burm., II., 387; Beddome, Fl. Sylv., t., 287; Gamble, Man. Timb., 363; Indian Forester, I., 93; Drury, U. Pl., 284; Lisboa, U. Pl. Bomb., 124.*

Habitat.—An evergreen tree 50 to 60 feet high: found in Sikkim up to 3,000 feet, the Mishmi and Khasia hills, Western Ghâts, and Andaman islands.

Resin.—Exudes a red resin similar to that of M. denticulata (*Kurz*). RESIN. 13

Structure of the Wood.—Grey, moderately hard: weight 33lb a cubic foot. TIMBER. 15

M. Roxburghii, *Wight; Fl Br. Ind., V., 448; Ic., t. 1949, f. 4.*

Syn.—MACARANGA WIGHTIANA, *Baill.;* M. TOMENTOSA, *Wight;* MAPPA PELTATA, *Wight (according to Sir W. Elliot)*, and apparently also OSYRIS PELTATA, *Roxb.*

Vern.—*Chandkal,* KANARA; *Chándwar, chandora,* MAR.; *Vatte kanni,* TAM.; *Boddi cheïtu* (? Elliot), TEL.; *Upligi, upalkai, kanchupranthi,* KAN.; *Chenthakanni,* MYSORE; *Bukenda,* SING.

References.—*Roxb., Fl. Ind., Ed. C.B.C., 712; Gamble, Man. Timb., 362; Elliot, Fl. Andh., 29; Dymock, Mat. Med. W. Ind., 2nd Ed., 689; Jury Reports, Madras Exhibition; Drury, U. Pl., 284; Cooke, Gums and Gum-resins, 34-35; Indian Forester, X., 33; Gazetteers:—Bombay XV., Pt. I., 72; Mysore and Coorg, I., 52.*

Habitat.—A small resinous tree found in the Deccan Peninsula, from North Kánara to Travancore, and on the Circars. Distributed to Ceylon.

The young shoots and fruits are covered with an adhesive reddish secretion which has an odour of turpentine. This fact, mentioned by many writers on Macaranga Roxburghii, agrees admirably with Roxburgh's description of his somewhat doubtful plant Osyris peltata.

MACHILUS odoratissima. — A Crimson Gum.

GUM. 16

Gum.—Cooke, in his account of the gums and resins formerly in the India Museum, quoting Drury apparently, says of this plant: "A gummy substance exudes from the cut branches and base of the petioles of these trees. It is of a light crimson colour, and has been used for taking impressions of leaves, coins, medallions, &c. When the gum is pure and carefully prepared, the impressions are as sharp as those of sulphur without its brittleness. Powdered and made into a paste it is reckoned a good external application for venereal sores." "The gum called *vutta thamary*, commented on in Madras jury reports, is the same substance: this is described as a simple pure gum of a crimson colour, exhibited from Travancore, and used for taking impressions of leaves, coins, medallions, &c." This same fact is alluded to in the *Mysore and Coorg Gazetteer*.

MEDICINE. Gum. 17 Plant. 18

Medicine.—In addition to the remedial properties assigned to the GUM in the above passage, the PLANT generally is used as a medicine. Dr. Dymock, for example, says: "The country people used the following in *jarandi* (*Angl.*, Liver):—One part of the young shoots, with three parts of the young shoots of *khoréti* (Ficus asperrima) are sprinkled with hot water and the juice extracted; in this is rubbed down two parts each of the barks of both trees. The preparation may be administered twice a day in doses of $\frac{1}{8}$th of a seer."

FOOD. Fruit. 19

Food.—Several writers allude to the FRUIT of this plant as having been eaten in times of famine.

MANURE. Leaves. 20

Manure.—Drury says: "The LEAVES afford a good manure for rice fields, and are much used for that purpose. Coffee-trees thrive well if planted under the shade of these trees, as the fallen leaves, which are large, enrich the soil."

Macaroni, see Triticum Vol. VI.; also Vermecelli, Vol. VI.

Macassar Oil, see Carthamus tinctorius, *Linn.*, COMPOSITÆ; Vol. II., 194.

Mace, see Myristica fragrans, *Houtt.*, MYRISTICEÆ; p. 311.

21

MACHILUS, *Nees; Gen. Pl., III., 156.*

The *Flora of British India* describes some ten species of Laurel as belonging to this genus. With the exception of M. odoratissima, none of the others appear to be of much importance. M. edulis, *King* (Phœbe attenuata, in Gamble's *Man. of Timbers, 308*) yields an edible fruit known in Dárjíling as *lepcha phal*, the tree being called *dudri* in Nepal and *phani* by the Lepchas. The wood of that species is much used in Dárjíling for tea chests. M. macrantha, *Nees*, is a fairly abundant tree from the Konkan southwards. It is known as *gumára* in the Konkan forests. It should thus be observed that Phœbe attenuata, *Nees*, as given in the *Flora of British India*, is a distinct plant from the *lepcha phal* described by Gamble.

22

Machilus odoratissima, *Nees; Fl Br. Ind., V., 139;* LAURINEÆ.

Syn.—MACHILUS INDICA, *Kurz;* M. RIMOSA, *Bl.;* LAURUS ODORATISSIMA, *Wall;* L. INDICA, *Lour.*

Vern.—*Dalchini, mith-patta, prora, badror, leddil, kálban, cháu, táura, chandna, shalanglú, múkrú, bajhol, shír,* PB.; *Rare,* HAZARA; *Kawala;* HIND.; *Kawala, lali, jagrikat,* NEPAL; *Phamlet,* LEPCHA; *Súm,* ASS. *Dingpingwait,* KHASIA.

References.—*Brandis, For. Fl., 378; Kurz, For. Fl. Burm., II., 291; Gamble, Man. Timb., 308; Stewart, Pb. Pl., 188; Mueller, Select Extra-Tropical Plants, 7th Ed., 230; Atkinson, Him. Dist., 316; Indian Forester:—I., 95-99; III., 189; V., 35, 212; VI., 125; VIII., 404; IX., 359; XI., 355; XII., 286, 454; Gazetteer:—Gurdáspur Dist., 55; Kew Off. Guide to the Mus. of Ec. Bot., 112.*

Habitat.—A large tree of the outer sub-tropical and temperate Himálaya, from Marí eastwards; ascending to 8,000 feet. Also found in the

Khásia hills and Burma. In Assam it grows gregariously, in large forests, and is used for feeding the silkworms (Antheræa assama) which give the *muga* or *múnga* silk.

Fodder.—Goats even will not eat the LEAVES of this plant, but in Assam, as already remarked, they are extensively employed to rear the *muga* silk worms on. FODDER. Leaves. 23

Structure of the Wood.—Grey, darkening, and turning red on exposure, soft to moderately hard, even-grained. Weight 40lb per cubic foot. Used in Darjeeling, where it is very common, for building, chiefly for native houses. Also for tea-boxes (*Gamble*). TIMBER. 24

Machinery, Woods used for—see Agricultural Implements, Vol. I., 145.

MACLURA, *Nutt.; Gen. Pl., III., 363.*

Maclura tinctoria, *D. Don;* URTICACEÆ. 25

THE FUSTIC.

References.—*Crookes, Hand-book of Dyeing, &c., 349, 405-406, 411, 672; Hummel, Dyeing of Textile Fabrics, 359, 364.*

Habitat.—A native of the West Indies, and of Central and South America; introduced into India.

Dye.—See the works quoted above. It can hardly be said to be as yet of any value in India. DYE. Wood. 26

Structure of the Wood.—Orange-yellow; hard. Weight 53lb per cubic foot. Used as a yellow dye and also in producing green shades. TIMBER. 27

MACROCHLOA, *Kunth; Gen. Pl., III., 1141.* 28

According to Bentham this, at most, constitutes a sub-genus of Stipa and includes S. tenacissima, *Linn.*, and S. arenaria, *Boot.* (*Linn. Soc. Jour., Vol. XIX., 60*).

Macrochloa tenacissima, *Kunth;* GRAMINEÆ. 29

Syn —STIPA TENACISSIMA, *Linn.*

References.—*Kew Report, 1877, 37; 1879, 33; 1880, 52.*

Habitat.—A rush-like grass, which grows plentifully on the sandy tracts of the Mediterranean coast, especially in Spain, Algeria, Morocco, and the Sahara. This is the true ESPARTO GRASS, which, from remotest times, has been used for making hats, mats, baskets, chairs, agricultural ropes, &c., and in which an immense trade has recently arisen for the manufacture of paper. Saccharum ciliare, *Anders.* (the *Munj*), has long been used for cordage, and forms a strong and useful rope, much employed by boatmen in the North-West Provinces Perhaps the best Indian substitute for ESPARTO is, however, Ischœmum angustifolium, which see: but Eriophorum comosum (Vol. III., 266) and Lygeum Spartum are also so employed It is admitted, however, by paper-makers that it will not pay to export Indian grasses nor to produce in India a bark fibre intended for competition with ESPARTO.

MACROPANAX, *Miq.; Gen. Pl., I., 945.*

Macropanax undulatum, *Seem.; Fl. Br. Ind., II., 738;* ARALIACEÆ. 30

Vern.—*Chinia*, NEPAL; *Prongsam*, LEPCHA.

Habitat.—A moderate-sized evergreen tree of the Eastern Himálaya, from 500 up to 5,000 feet: also common in Assam and Sylhet.

Structure of the Wood.—Soft, yellowish-white, even-grained. Weigh 30lb per cubic foot. TIMBER. 31

Habitat.—An evergreen tree of the tropical Himálayan forests from Nepal to Assam, the Khásia hills, Chittagong, Burma: ascends to altitudes of 3,000 feet. Masters, in his account of the Angami Naga Hills, says, this tree is common on the lower undulations and plains immediately at the base of the mountains. Cultivated in gardens throughout the hotter parts of India—Calcutta to Mysore—on account of its sweetly-scented elegant flowers.

Mr. C. Nickels [*Jour. Agri.-Hort. Soc. (New Series), V., 67 and 68*] gives a useful note on the method of propagating this ornamental tree.

52 **MAGNESIA,** *Ball, in Man. Geology of India, III., 437.*

The principal sources of the salts of this metal, which are of economic value, are magnesite—the carbonate, and epsomite—the sulphate of magnesium. The metal also occurs as a silicate under three different forms—talc or steatite, meerschaum, and serpentine—which will be separately described.

53 **Magnesia,** *Mallet, Geology of India, IV. (Mineralogy), 145, 152.*

MAGNÉSIE, *Fr.*; BITTEVERDE, *Ger.*; MAGNESIA, *It.*

Vern.—Hydrated oxide = *Zahr mohra*, PERS., HIND., PB.; Sulphate = *gurm*, BHOTE.

References.—*Forbes Watson, Industrial Survey of India, II., 419, 422; Baden-Powell, Pb. Prod., 47, 99; Pharm. Ind., 339-342; Ainslie, Mat. Ind., I., 304, 629; Balfour, Cyclop., II., 769*

OCCURRENCE. 54 Occurrence.—According to Ball, epsomite, or natural sulphate of magnesia, is doubtless to be found as an efflorescence in many parts of India, since it is an occasional constituent of *reh*, but its occurrence appears to have been described only at Spiti. In that locality, Mallet found it as a plentiful efflorescence on black slate, in connection with considerable deposits of gypsum and arragonite. By collection and lixiviation of the fragments, he stated that a considerable supply might easily be obtained. Mr. Mallet, in his *Mineralogy*, (written seven years later than Ball's account) further states that epsomite is a frequent constituent of *reh*, and gives analyses of two samples from the Chánda district, which, by lixiviation and evaporation, afforded 16·02 and 11·86 of the salt respectively. He also mentions that the mineral occurs in considerable quantity in the Phurwalla salt mine of the Salt Range, impregnating, and efflorescing from, a bed of marl at least seven feet thick. It is also said to be found less plentifully in the other mines, in the thin seams of marl which sometimes separate the good salt layers from each other. Dr. Warth discovered an interesting hydrous sulphate, named *kieserite* mixed with sylvine (potassic chloride) in a lenticular deposit from two to three feet thick in the Mayo salt mines. Fifteen maunds of the mixture was collected, but no information exists of its having been met with since.

Epsomite has also been reported as occurring as an efflorescence on alluvial clay in the Nicobars Magnesite, or the carbonate of magnesia, is generally found in veins associated with other magnesian rocks such as serpentine, dolomite, &c. Mr. Mallet writes that "it forms innumerable veins in talcose, chloritic and hornblendic rocks over a large area in Salem, in the Madras Presidency. Associated with it are baltimorite, chalcedony, jasper, chromite, and talc. According to Lieutenant Ochterlony, it also occurs in Trichinopoli, Coimbatore, and Mysore, and Newbold says it is met with at Nellore.

Two analyses of the magnesite from Salem, made by Prinsep, and by Sturneyer, reveal that the mineral contains about 48 per cent. of magnesia. Veins of magnesite have been reported by Blanford as occurring in the serpentine of the Arakan range in Burma, and by Oldham under the same circumstances in Manipur. Impure magnesite has recently been discovered

by Captain Pogson in the dolomitic limestones of the Happy Valley near Mussoree. This, examined by Dr. Warth, was found to yield 69·1 per cent. of the pure carbonate (*Mallet*).

Medicine.—The OXIDE (magnesia), the CARBONATE, and the SULPHATE are largely employed in European medicine, the two former as antacids and laxatives; the latter, as a purgative, refrigerant, and diuretic.

MEDICINE. Oxide. 55 Carbonate. 56 Sulphate. 57

No record exists in the literature of India of the use of the compounds of magnesium as medicine excepting in the case of the impure hydrated oxide, *sahr-mohra*, which is employed in Northern India as a laxative, alterative and aphrodisiac. Ainslie talks of calcined magnesia as a useful remedy in sporadic cholera, and of the sulphate as a valuable purgative and alterative, but makes no mention of their being employed by Natives in the south of India, in parts of which the sulphate or natural epsom salts, as already stated, occurs plentifully. A recent note received from Surgeon-Major Aitchison, states that "a coarse natural product collected near Rúpshú, probably a sulphate of magnesia, called *gurm* by the Bhotes, is used by them as a purgative."

The salts above enumerated are all officinal in the *Pharmacopœia*, but are entirely imported for use. They are mostly artificially manufactured from sea-water, from magnesian limestones, or from magnesite, by treatment with sulphuric acid.

INDUSTRIAL. Sulphate. 58

Industrial Use.—Besides the well known medicinal purposes to which Epsom salts are put, they are said to be also sometimes employed to give weight to cotton cloth. Dr. McLeod, and later M. Sorel, proposed to manufacture a water cement from the Salem magnesite, by mixing it, when powdered and calcined, with a solution of chloride of magnesia.

Mahogany, see Swietenia Mahagoni, MELIACEÆ; Vol. VI.

Mahonia nepalenis, *DC.*, see Berberis nepalensis, *Spreng.*; Vol. I., 446

Mahwa or **Mahuá**, see Bassia latifolia, *Roxb.*, SAPOTACEÆ; Vol. I., 406

Maiden-hair Fern, see Adiantum Capillus-veneris, *Linn.*; FILICES; [Vol. I., 110.

Maize, see Zea Mays, *Linn.*; GRAMINÆ; Vol. VI.

MÁJUN (vulgarly Májum). 59

Májun is an intoxicating sweetmeat prepared with *ghí* and sugar, the drug being *Bhang*, *Gánja* or *Charas* (the narcotics of Cannabis sativa, which see, *Vol. II., 113—118*); Opium or Poppy-seeds; or *Datura*. The preparation is flavoured with various spices, such as Cloves, Mastich, Cinnamon, Aniseed, Cummin, Cardamon, &c.. &c. For further information, see the article Narcotics, pp. 324—326 and 328.

MALACHRA, *Linn.*; *Gen. Pl.*, *I.*, 205.

Malachra capitata, *L.*; *Fl. Br. Ind.*, *I.*, *329*; MALVACEÆ. 60

Vern.—*Ran* or *ban-bhendi*, BOMB.

References.—*Voigt, Hort. Sub. Cal., 112; Dals. & Gibs., Bomb. Fl., 9; Murray, Pl. and Drugs Sind, 60; Lisboa, U. Pl. Bomb., 227; Liotard, Paper-making Mat., 79, 80, 81; Report, Exp. Farm Khándesh, Bombay; Dec. 1880; Cross, Bevan & King, Report on Fibres of India, 54; Jour. Agri.-Hort. Soc. Ind., V., (new series), Pt. VI. (Proc. 1878), 25, 48; Indian Forester, VII., 179; Spons, Encyclop., 981; Balfour, Cyclop., 804.; Official Corresp., R. and A. Dept. B. Proc., 1881.*

Habitat.—An erect annual, with broad, heart-shaped leaves, covered with stiff hairs. The flowers are yellow or white, and form axillary or terminal heads. None of the earlier botanical writers allude to this plant,

from which circumstance it is presumed to be a modern introduction. It is a native of west Tropical Africa (the Congo basin particularly), and of Tropical America. Voigt is the first Indian writer who makes mention of the plant, and in *his* day it would not appear to have been so plentiful as at the present time, since he simply remarks that it is domesticated about Serampore. Graham, and after him Dalzell & Gibson, affirm that the plant was introduced into Bombay from Brazil by the late Mr. Nimmo. It is now plentiful throughout the hotter damp tracts of India, more especially in the vicinity of Bombay.

FIBRE.

FIBRE. 61

Fibre.—It yields a fibre 8 to 9 feet long, with a silvery lustre, and almost as soft as silk. Dr. King reports that for paper-making this does not seem to promise much; it has, however, been experimented with in Bombay as a substitute for jute and was reported on favourably by the manager of a factory. The fibre was shown at the late Colonial and Indian Exhibition, an excellent sample having been presented by Mr. A. B. Gupte. At one time high hopes were entertained that Bombay would, in this fibre, possess the means of competing with the Bengal jute manufacturers. Just as the growth of the jute industry eclipsed all the other fibres that were, half a century ago, equally contesting the growing market for a cheap textile, so twenty years later, the immense popularity of the Bombay wheat trade seems to have extinguished the hopes once entertained of this fibre. The reports published regarding it are, however, unanimous, that it is little if at all inferior to jute, and that capital directed towards the cultivation and manufacture of the fibre is all that is needed to place the industry on a sound commercial basis. The efforts to introduce the cultivation of jute into Bombay may be pronounced a failure, and there would, therefore, seem every prospect of a new interest being taken in this neglected fibre. Malachra fibre was much admired at the Colonial and Indian Exhibition, and the experts, who examined it, were of opinion that Bombay would not much longer continue to import the sacking required for her grain trade, and that some enterprising manufacturer would soon be found willing to use this, or some other allied fibre in the preparation of gunnies for the local market. In the hope of usefully placing in the hands of the public existing information the following reprint may be here given.

Notes, &c., on the Experimental Cultivation of Malachra capitata *in Bombay.*

Mr. J. E. O'Conor, then Assistant Secretary to the Government of India in the Department of Revenue, Agriculture, and Commerce, on the 15th April 1878, wrote of this plant and its fibre:—

"Among the specimens of raw produce collected in Bombay for the Paris Exhibition were samples of fibre extracted from Malachra rotundifolia (so named in the list of Bombay contributions). Regarding that specimen, the following remarks were made in a memorandum attached to the list of contributions:

'From this plant, which grows abundantly during the rains in waste places in and near Bombay, Dr. W. Gray, M.B., extracted a fine fibre and sent it to the proprietor of the Bombay Hemp and Jute Mill for examination. It was most favourably reported upon. At the beginning of the last monsoons the proprietor was, at his own request, taken to the Byculla flats in Bombay and the plant was shown to him. He remarked that the usefulness of this plant was not known, and reported that the discovery is 'a boon to Bombay.' He has subsequently taken steps in procuring fibre from this plant, and about forty day labourers were till now kept working by him at Chembive, a village near Coorla. A new industry has thus been started. This fibre perhaps deserves special attention.'

Struck with these remarks, I asked the officer who was in charge of the Bombay collections for Paris, and who had prepared the list (Mr. F. F. Arbuthnot, C.S.,

and Substitute for Jute. (*G. Watt.*) MALACHRA capitata.

FIBRE.

Collector of Bombay), to be good enough to furnish me with some further information on the subject and samples of the fibre, as well as of the plant itself. Mr. Arbuthnot was not able to send me any of the fibre, the whole quantity prepared by the mill-owner referred to above after the monsoon having been already exhausted. He has mixed the fibre with jute and made gunny-bags of the mixture. Mr. Arbuthnot sent me samples of the plant, however, and the copy of a letter from the mill-owner to Dr. Gray on the subject of the fibre. The letter was to the following effect:—

'I have received through your friend, Mr. B., a sample of a nicely-cleaned new fibre taken from a jungle plant, and being new it gave me extra pleasure in testing it, and I can safely say that the new fibre is quite as good as jute. If this new fibre can be grown in quantity, it will be a great thing and a boon to this Presidency. The fibre is actually not the yarn of jute; nor do I know its true name. It seems like what the natives call *ranee bhendee*, or jungle *bhendee*; but even that is doubtful, as *bhendee* is scarcely so good as this fibre.

'The fibre is in length from 8 to 9 feet, thoroughly clear from gummy substance and dirt, has a nice silvery appearance with a peculiar lustre, and is almost as soft as silk. In passing the fibre through the machinery, damped with oil and water, as is commonly done with Bengal and Konkan jute, yarn was produced strong enough and nearly equal to that made from the second quality of Bengal jute. In the opinion of our European spinning-master, owing to the almost imperceptible difference between the yarn made from the new substance and Bengal jute, it is very suitable for weft; but if the plant is carefully grown and well looked after, the fibre would then, no doubt, rank fully equal to Bengal and Bombay Jute. Owing to the high prices ruling for jute in Bengal and elsewhere, the new fibre, if carefully prepared, would command a ready sale at R3-12 to R4 per Indian maund.' *

I submitted the specimens of the plant, and the papers received from Bombay, to Dr. King, Superintendent of the Botanical Gardens, Seebpore, who had kindly offered to identify and name the plant. He says that the plant is Malachra capitata, and not M. rotundifolia, which is found only in South America, and he adds—

'Malachra capitata, though probably originally a native of South America also, is now found everywhere within the tropics. It now grows sparingly about Calcutta; but, as it is not mentioned by Roxburgh in his *Flora Indica*, it appears probable that it did not occur at all here in his time. Wight and Arnott do not mention it in their *Prodromus Floræ Peninsulæ Indiæ Orientalis*, and it is, therefore, improbable that it was common in Southern India when that book was written. I should not anticipate any difficulty about growing the plant in Bengal; but whether it would yield as good a fibre or be as valuable as jute, I am quite unprepared to offer an opinion. The plant belongs to the new order MALVACEÆ. It is an erect annual (or occasionally perennial) shrub, covered everywhere with very stiff hairs. The leaves are broadly heart-shaped, almost rounded, and are borne on long stalks. The flower-heads are also carried on long cylindrical stalks which rise from the axils of the leaves. The flowers themselves are yellow or white in colour. There are about five or six of them on each head, and they are surrounded at their origin from the flower stalk by three or four half-kidney-shaped bracts. Each flower produces five seeds.'

The above is a popular description. Sir J. D. Hooker's description in the *Flora of British India* is to the same effect, though stated in botanical terminology. Sir Joseph Hooker writes of this plant (M. capitata) that it occurs throughout the hotter parts of India from the North-Western Provinces to the Carnatic, probably introduced.

The members of the family are usually found in marshy places within the tropics. It would seem, therefore, that this species would thrive well in Bengal; in fact, it is already common about Calcutta; and Voigt (*Hortus Suburbanus Calcuttensis*, page 112) refers to it as domesticated in his time (1841) about Serampore. Mr. Blechynden tells me that Graham, in his Catalogue of Plants in Bombay and its vicinity, alludes to Malachra rotundifolia as introduced by Mr. Nimmo about forty years ago.

The preparation of the fibre is the same as that of jute. When Dr. Gray operated on the fibre in Bombay, he steeped the stem in water for a week. It must be steeped when freshly cut; for, according to the experience of the mill-owner, who tried the fibre, if the stem is exposed to the sun and allowed to dry, great difficulty is felt in getting rid of the external bark, and the fibre obtained is coarse and inferior in quality.

* This letter was dated 20th July 1877.

ALACHRA capitata. **Malachra Fibre.**

FIBRE.

The utilisation of this plant would be specially advantageous in the Bombay Presidency, where as yet attempts made to grow jute can hardly be said to have had any success. But the plant seems to merit attention in Bengal too. Growing as it does and flourishing without any attention in marshy soil, of which we have more than enough for all purposes in Lower Bengal, it would seem to offer the spinners and paper-makers an excellent substitute for, and addition to, jute. I believe the Bally Paper Mill Company are anxious to find some fibrous product capable of conversion into paper at low cost. Here is one to their hand, and I beg to recommend it to their attention, as well as to that of jute-spinner's and rope and twine makers.

In Balfour's *Class Book of Botany* (page 771) it is said that in Panama the leaves of this plant are used as an anthelmintic.

Reports obtained through the Agricultural and Horticultural Society of India on a sample of the fibre of "Malachra capitata" *prepared in Bombay by* Surgeon-Major W. Gray.

I have no doubt this fibre would prove a good substitute for jute for most purposes to which jute is applied; but it seems rather more harsh, and its spinning qualities should be tested in one of the jute-mills before giving a very decisive opinion. To ascertain whether it would prove economically a substitute for jute, we should require to know the yield of fibre per bigha or acre, and the cost of cultivation and manufacture.

(Signed) S. H. ROBINSON.

This sample is beautifully bright and clean, fair length, and good strength of staple, but somewhat harsh. I doubt if it would make a good warp yarn in itself, but mixed with good jute it would do so. The fibre for spinning is not so valuable as jute; it lacks the forked ends when broken, such as the latter possesses, and partakes of the character of the fibre known as *meshta*, which when broken looks as though it had been cut and left with square ends. Before its value as spinning fibre could be fairly assessed in competition with jute, it would be needful to show cost of production, outturn per *bigha*, &c.

(Signed) W. H. COGSWELL.

Fibre harsh.

(Signed) W. STALKART.

Extract, paragraph 3, of a letter from the Acting Collector of Tanna, No. 3298, dated 24th October 1878.

3. The seed of the Malachra capitata, which formed the subject of correspondence ending with Government Resolution under reference, was sown broadcast during the monsoon just over in *gurcharan* or waste land in Bandora taluka, Salsette, and in certain villages of Bassein and Kalyan talukas, and the result is reported to be a complete failure. This result is apparently attributable to the exceptionally heavy fall of rain, and I would recommend a further trial next season.

The following report was received from the Superintendent of the Victoria Gardens, Bombay, in 1879:—

'Not having any seed of the plant in stock, and none being procurable in the bazár, I gathered a quantity of young plants from the flats, as soon as they appeared after the commencement of the rains, and planted them in regular rows 3 inches apart, with a space of 1½ inches betwixt each plant. The soil was stony and loose, formed of a mixture of decayed *cutchra* and the natural soil of the garden. The plant grew very rapidly, and after three months' growth reached a height of 7 to 8 feet, each stalk perfectly straight, and measuring at the root from ¼ to ¾ inch in diameter. After four months' growth the plants were cut down, all leaves, branches, and seeds removed, exposed to the sun for three days, and then steeped in water for five days; they were then removed stalk by stalk, and all the fleshy or pulpy part removed by pressing with the finger and thumb. The outcome is as follows: from a Bengal *bigha*, or an area of 1,600 square yards, fibre (the same as sample sent) can be produced weighing 560lb. When cultivated during the rains, the plant requires no attention whatever; but it must be grown very close together and not exposed to high winds. The cost of removing the fleshy matter from the fibre will amount to about R3 per *bigha*.'

The Superintendent, Khándesh Experimental Farm, Bombay, wrote (26th February 1879) to the Collector of Khándesh:—

'As directed in Government Resolution No. 2362 of 8th May 1878 (forwarded under your endorsement No. 2154 of 13th idem), I have the honour to report on the Malachra capitata (*Syn.* rotundifolia) as a fibre-producing plant.

2. This species of mallow was introduced into Khandesh presumably at a recent date, although there seems to be no very trustworthy information on the subject. It

FIBRE.

is known here by the name of *ran bhendee*, and the cultivators are more or less familiar with the quality of its fibres, which they sometimes extract.

3. It is found only in good soil, and makes its appearance soon after the first rain. Its leaves much resemble those of the cotton plants in its young state, and on this account often grows along with that crop for a month or more before being discovered.

4. I have conducted many experiments in the utilisation of this waste fibre as well as in the cultivation of the plant as an ordinary crop. I find that the best fibre is produced from green stems, and they are ready for cutting in the early *kharif* harvest, or in time to admit of a light *rabi* crop being sown afterwards, and that the crop does not exhaust the soil as in the case of *sunn* hemp.

5. The habit of the plant is very peculiar: it throws up in the first place a strong central stem, several feet high, furnished with a few straggling lateral shoots. The best fibre is got from an abundance of radical shoots, which remain procumbent and to a distance of 4 or 5 feet, where the ends become slightly bent upwards to admit of the thorough ripening of the cluster, or head of capsules which contain the seeds of the plant.

6. A bale of this fibre, along with seven other kinds, were forwarded to Government in accordance with the instructions contained in paragraph 8 of the Resolution No. 1881 of 7th July 1874. The whole was sent through the Secretary of State to the Dundee Chamber of Commerce, who merely recorded a general opinion on the whole batch without dealing with the merits of any particular sample.

7. The *ran bhendee* fibre is easily extracted, as the bark contains comparatively little of the gummy substance so common to many others of the fibre-producing plants.

8. Notwithstanding the large number of "miscellaneous fibre" shown at the late Mahiji Exhibition, two of the three prizes offered under this head were awarded to samples of *ran bhendee*.

9. I have had a parcel of the fibre prepared, and await your orders regarding its despatch.'"

The above compilation of available information was first published by the writer in the Selections from the Records of the Government of India, in the Revenue and Agricultural Department (1888-89), since which date no further particulars have been obtained. The fibre seems well worthy of careful investigation *1st*, as to whether it can be produced in Bombay at a price to compete with Jute; and *2nd*, whether it can be as cheaply and economically utilised.

Malabar Oil. 62

The ambiguous term 'Malabar Oil' is applied to a mixture of the oil obtained from the livers of several kinds of fish frequenting the Malabar Coast of India and the neighbourhood of Karachi. The species chiefly used belong to the genera **Ætobatis, Carcharias, Clupea, Pristis, Rhynchobatus, Silundia, Trygon,** and **Zygæna.**

See the article **Fish** in Vol. III., 363-397.

Male Fern, see the article **Ferns,** Vol. III., 323.

MALCOLMIA, *Br.; Gen. Pl., I.,* 77.

[*146;* CRUCIFERÆ.

Malcolmia africana, *Br.;* and **M. strigosa,** *Boiss.; Fl. Br. Ind., I.,* 63

Vern.—*Khunseráia, patthra, páchan, chináka,* PB.

References.—*Stewart, Pb. Pl., 14; Murray, Pl. and Drugs Sind, 50; Stewart, Account of a Journey in Hazára and Khágán (Jour. Agri.-Hort. Soc. Ind., XII.); Aitchison, Rept. Botany, Afgh. Del. Com.; Lace, Report on the Vegetation of Quetta (in mss.).*

Habitat.—Small, herbaceous weeds found in the hotter parts of North India (Panjáb, Sind, Balúchistán, and Afghánistán), where, according to Stewart, the last mentioned species (in Hazára) is so abundant as to carpet the ground, and give it a heather-like purple hue. The first mentioned species ascends from the Panjáb plains to altitudes of 13,000 feet above the sea

FODDER. 64

Fodder.—These, along with a few other equally abundant cruciferous plants (principally Lepidium Draba), are greedily eaten by goats and sheep, and in Quetta may have much to say to the superiority of the mutton reared in that neighbourhood. M. Bungei, *Boiss.*, occurs in Peshín Valley (*Lace*). Of this species Aitchison reports that in the Hari-rud Valley it is in so great abundance, on gravelly soil, as to give a bright colour to the country. Mr. Lace states that in Peshín it is an important fodder plant, and doubtless this is the case also in Afghánistán.

65

MALLOTUS, *Lour.; Gen. Pl., III., 319.*

A genus of trees or shrubs, comprising some 70 species, natives of the tropical areas of the Old World. The arborescent forms yield soft, light, woods of no great economic value. In India there are 45 species: 2 of these occur throughout the hotter parts of the continent; 9 in Madras; 5 along the foot of the Himálaya; 6 in Assam; 15 in Burma; 4 in the Andaman islands; 7 in Ceylon; and 22 in the Malay Peninsula—Burma to Singapore. The following are the more important species.

[*1873;* EUPHORBIACEÆ.

66

Mallotus albus, *Muell. Arg.; Fl. Br. Ind., V., 429; Wight, Ic., t.*

Syn.—M. TETRACOCCUS, *Kurz;* ROTTLERA ALBA and TETRACOCCA, *Roxb.;* R. MAPPOIDES, *Dalz.;* R. PELTATA, *Wight;* R. PANICULATA, *Wall.*

Vern.—*Marleya,* SYLHET; *Jogi mallata,* NEPAL; *Numbong,* LEPCHA.

References.—*Roxb., Fl. Ind., Ed. C.B.C., 737; Brandis, For. Fl., 444; Kurz, For. Fl. Burm., II., 383; Beddome, For. Man., 208; Gamble, Man. Timb., 361; Dalz & Gibs., Bomb. Fl., 230; Bombay Gazetteer (Kánara), XV., Pt. I., 443.*

Habitat.—A small, evergreen tree, found in Sikkim, Eastern Bengal, Assam, Chittagong, the Western Ghâts, Mysore, and Ceylon. On the Himálaya it ascends to altitudes of 3,000 feet.

TIMBER. 67

Structure of the Wood.—Soft, white: weight 31lb per cubic foot.

68

M. muricatus, *Muell. Arg.; Fl. Br. Ind., V., 437.*

Under the above name, Gamble, Kurz, and other writers on Indian Economic Products have described a tree which yields a grey, moderately hard timber. The *Flora of British India* (*Vol. V., 436, 437, 439*) points out that the tree of Mysore and Travancore so designated is M. muricatus, *Beddome:* that of Ceylon M. Walkeræ, *Hook. f.:* and the Andaman plant is M. andamanicus, *Hook. f.,* the *Duk-mouk,* of the Burmese.

69

M. nepalensis, *Muell. Arg.; Fl. Br. Ind., V., 428.*

Syn.—M. OREOPHILUS, *Muell. Arg.; Gamble, Man. Timb., 362.*

Vern.—*Numbúngkor,* LEPCHA; *Safed mallata,* NEPAL.

Habitat.—A small tree of the Central and Eastern Himálaya: Nepál, Sikkim, altitude 5,000 to 7,000 feet, Khásia Hills 4,000 to 5,000 feet.

TIMBER. 70

Structure of the Wood.—White, soft; growth moderately fast, five rings to the inch of radius (*Gamble*).

71

M. philippinensis, *Muell. Arg.; Fl. Br. Ind., V., 442.*

THE MONKEY FACE TREE.

Syn.—ROTTLERA TINCTORIA, *Roxb.;* R. AURANTIACA, *Hook. & Arn.;* R. AFFINIS, *Hassk.;* R. MONTANA and MOLLIS, *Wall.;* CROTON PHILIPPENSIS, *Lamk.;* C. PUNCTATUS, *Retz.;* C. COCCINEUS, *Vahl.;* C. MONTANUS, *Willd.;* C. DISTANS, *Wall.;* C. CASCARILLOIDES, *Raeusch.*

Vern.—*Kambilá, kamúd, kamalá, kamilá, kamelá, rúin, rúlú, kambhal, wusantha-ganda* (powder), HIND.; *Rori* (LOHARDUGGA); *Dhola sindur,* (BIRBHUM); *Sinduri* (DARJILING); *Kamilá, túng* (*kishur* or *késar*=saffron), *kamalágura* (the dye powder), *kamalágundi,* BENG.; *Kumala, súndragundi, bosonto-gundi,* URIYA; *Rora,* SANTAL; *Gangai, puddum, jaggarú,* ASSAM; *Chinderpang, machugan,* GARO; *Sinduria, safed mallata,* NEPAL; *Puroa, tukla, numboongkor,* LEPCHA; *Baraiburi, sin-*

Kaméla. (*G. Watt.*) MALLOTUS philippinensis.

durpong, MICHI; *Koku*, GOND; *Reoni, roli, kamela* (BANDA); *Rúinia kamela*, (BIJNOUR); *Rori* (BUNDELKHUND); *Sindúria, puroahung*, N.-W. P.; *Rohni*, OUDH; *Rúen, riúna, roli, rauni, rerú*, KUMAON; *Kaimbil*, KASHMIR; *Kamela, kamal, kambal, kúmila, reini, reun, rúlyá*, PB.; *Kámbaila* (PESHAWAR), PUSHTU; *Rauni, rori, chamar gular, ningur*, C. P.; *Kúkú* (MELGHAT), BERARS; *Shendri, kapela, kamala*; BOMB.; *Shendri, shindur*, MAR.; *Kapilo*, GUZ.; *Kapli, kapila, kamela-mávu* (*? pod* =pollen), TAM.; *Kúnkúma, kápila, vassuntagunda* (powder), *chendrasinduri*, TEL.; *Kurku, rangamále, corunga-manje, sarnakasari, kulichellu, kunkuma*, KAN.; *Ponnagam* (? **Calophyllum inophyllum**), MALAY.; *Taw-tee-cteng, tan-thie-den*, BURM.; *Tawthadin*, SHAN; *Hamparandella*, SING.; *Kapila, kampilla* (the red mealy powder), *rechanaka* (*Punnaga* is incorrectly given in many books as Sanskrit for this plant,—see **Calophyllum inophyllum**), SANS.; *Kinbíl* (a word derived from the Sanskrit and now restricted in India to this plant), ARAB.; *Kanbélá*, PERS.

References.—*Roxb., Fl. Ind., Ed. C.B.C., 737; Brandis, For. Fl., 444; Kurs, For. Fl. Burm., II., 381; Beddome, Fl. Sylv., t. 289; Gamble Man. Timb., 361; Dalz. & Gibs., Bomb. Fl., 230; Stewart, Pb. Pl., 197; Grah, Cat. Bomb. Pl., 184; Mason, Burma and Its People, 512, 543, 761; Benth., Fl. Hongk., 307; Hooker, Him. Jour., I., 315; Miquel, Fl. Ind Bat. Suppl., 454; Rheede, Hort. Mal., V., t. 21, 24; Elliot, Flora Andhrica, 36, 86, 95, 96, 98, 103, 151, 168, 185, 189, 190; Pharm. Ind., 202; British Pharm., 167; Moodeen Sheriff, Supp. Pharm. Ind., 170; U. C. Dutt, Mat. Med. Hind., 232, 302; Dymock, Mat. Med. W. Ind., 2nd Ed., 709; Fluck. & Hanb., Pharmacog., 572-576; U. S. Dispens., 15th Ed., 828; Bent. & Trim., Med. Pl., IV., t. 236; Murray, Pl. and Drugs, Sind, 34; Med. Top. Ajm., 142; Irvine, Mat. Med. Pat., 48; Buchanan, Journey through Mysore, Canara, &c., I., 168, 204, 211; II., 343; Baden Powell, Pb. Pr., 376; Atkinson, Him. Dist., 776; Drury, U. Pl., 285; Lisboa, U. Pl. Bomb., 122, 248, 258, 268, 275; Birdwood, Bomb. Pr., 78, 301, 336; Royle, Ill. Him. Bot., 329; McCann, Dyes and Tans, Beng., 18-20; Buck, Dyes and Tans, N.-W. P., 31; Liotard, Dyes, 56-58, 89, 90, 125; Wardle, Report on India Dyes, p. 5; Darrah, Note on Cotton in Assam, 33; Aplin, Report on the Shan States, 1887-88; Prof. Hummel, (Special Report in connection with Colonial and Indian Exhib.); Kew Reports, 81, 50; Kew Off. Guide to the Mus. of Ec. Bot., 119; For. Admn. Report Chutia-Nagpore, 1885, 34; Bomb. Gaz., XI., 25; XV., i., 75; Lamk, Encycl., II., 206; Indian Forester, Vol. III., 24, 204; Vol. IV., 230, 318, 323; VIII., 106, 119; IX, 413; X., 33, 325; XI., 367; XII., 188 (XXII.); XIII., 121; Gazetteers:—N. W. P., I., 34; II., 173; IV., 77; X., 317; Bombay, XV., 72; XVII., 26; Panjáb, Hoshiárpur District, 10; Rawalpindí District, 15, 83; Peshawar District, 2; Mysore and Coorg, I., 48, 436; II, 7; III., 22; Hunter, Orissa, II., 179, Ap. VI.; Manual of the Cuddapah District, 200; Settlement Report of the Upper Godávery District, 38; Central Provs. (Raipur Dist.), 76; (Chanda District), Ap. VI.; Agri.-Hort. Soc. (Old Series), IV., Pt. I., 210, 211; VI., Pt. I., 27; VIII. Sel., 178; XIII., 314, 353, 390, 391; XIV., 21, (New Series), I., 103; VI., Sel., 20; Honigberger, Thirty-five years in the East., 337.*

Habitat.—A small, evergreen tree, found throughout Tropical India; along the foot of the Himálaya from Kashmír eastwards (ascending to 5,000 feet); all over Bengal and Burma, Singapore, and the Andaman Islands; and from Sind southwards to Ceylon. Distributed to China, the Malay Islands, and Australia.

THE KAMÉLA DYE.

HISTORY. 72

History of the Dye and Medicine.—Much has been written regarding the *Kaméla* dye (or as it is known in Europe *Kamala*). This is the powdery substance obtained as a glandular pubescence from the exterior of the fruits of **Mallotus philippinensis.** Even at the present day, however, *Kaméla* dye cannot be said to have obtained the position in European commerce, which its merits deserve. In India it is sometimes known by its Arabic name *Kinbíl* (a word derived from the Sanskrit name for the drug); but, according to certain Arabian writers, there were two kinds of

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Kinbíl, the red Indian and the black or purple Abyssinian. It has now been ascertained that the darker coloured *Kinbíl* is the African *Wars* or *Waras* drug and dye, a substance obtained from a Flemingia (*see Vol. III., 400-403*). The Indian *Kin'íl* appears, in fact, to have at one time been chiefly used as an adulterant for *Wars*, and as such it first found its way to Europe. The history of the black *Kinbíl* has been more carefully worked out than the red, though what is apparently the latter is mentioned in the *Chakradatta-sangráha* and in the *Bhávaprakása* (A.D. 1535), and hence was probably known to the later Sanskrit medical writers. Professor Wilson was of opinion that the Arabians of the eighth century studied Hindu medicine before that of the Greeks, and that Chakrapani Datta's great work was translated into Arabic about A.D. 773. From that period the name *Kinbíl* probably dates. Arabian writers of an earlier period appear to allude exclusively to *Wars*, the synonym *Kinbíl* being given by commentators or translators. Thus Paulus Aegineta in the seventh century refers to *Wars* and Ibn Khurdadbah, who lived A.D. 869-885, states that from Yemen came stripe silks, ambergris, *wars*, and gum. *Kinbíl* is sometimes compared by the Arabian writers to saffron, hence in all probability the modern though inaccurate application of the vernacular name *késar* in some parts of India. This mistake was made by Brandis, Gamble, Bentley & Trimen, &c. In the tenth century, Masundi wrote of *Kinbíl* as a sandy substance of a red hue, which was useful as an anthelmintic and in the treatment of cutaneous diseases In the thirteenth century, Kaz-wini referred to *Wars* as a plant sown in Yemen which resembled Sesam. Most writers from that date carefully distinguish *Wars* from *Kinbíl*, and speak of the former as a dye and medicine used externally to remove freckles and taken internally to cure leprous eruptions. They seem to have understood that the red *Kinbíl* was an anthelmintic drug—a property not possessed by *Wars*. The *Makhzan el-Adwiya* makes the same distinction, but says the *Kinbíl* is the pulp of a fruit obtained from a tree growing on the mountains which has long stiff thorns. It is thus probable that Mir Muhammad Husain never saw either the tree or the fruits from which the *Kaméla* powder is obtained. His description of the fruit and of the powder obtained from the interior (instead of from the outer surface) is curiously enough almost identical with that incorrectly given by Liotard, McCann, and other popular modern writers on the dyes of India. Of *Wars*, Mir Muhammad remarks there is a black kind which comes from Ethiopia, called *Habshí* and a dull red kind known as Indian, the latter yielding an inferior dye. He then adds that the seeds of the *Wars* plant resemble those of *másh* (=Phaseolus Mungo *var.* radiata), a fact which recent investigation has confirmed, by the determination of *Wars* as the glandular pubescence from the pods of a Flemingia.

The vernacular names used in India to denote the *Kaméla* powder imply its colour, but they are the same names as are given to the disease jaundice It is somewhat remarkable, however, that the earliest European writer who deals with Mallotus philippinensis should neither have heard of its dye, nor of its anthelmintic property. In 1684 Rheede (*Hortus Indicus Malabaricus*) described and figured the plant, but he speaks of the leaves and fruits as being made, along with honey, into a cataplasm employed in the treatment of itch and for application to the bites of snakes and other venomous animals. Similarly, the root, he adds, was made into a preparation found valuable in the treatment of contusions, since it possessed the property of dissolving coagulated blood. He does not appear to have heard of the powder, nor does he call the plant by a name in any way traceable to the names in modern use. He calls it *Ponnagam*, but, as with Roxburgh's *Poonag*, that name should in all probability be assigned to Calophyllum ino-

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phyllum. Dr. Hove, an indefatigable traveller and botanist, who visited Bombay in 1787, alludes to *Kaméla* apparently, but under another incorrect name—'*Kissury*,'—as being used to adulterate a permanent dye prepared from Bixa Orellana by combining the dye from the seeds with that prepared from the roots and leaves.

The reader will find (in the Selections from the Records of the Government of India, Revenue and Agricultural Department, 1888-89, pp. 53-58) an account of Hove's dye, and perhaps the facts there given may be found interesting, because of their bearing on the subject of *Kaméla*. Most writers speak of Buchanan as having been the first European writer who described *Kaméla* dye. The Diary of his Journey through Mysore, in which he gives particulars of the process then in use, is dated 1807, but Roxburgh's *Coromandel Plants* was published in 1798. In that work the subject is discussed in great detail, and the genus Rottlera, by Roxburgh, founded in order to isolate from Croton the *Kaméla* and one or two allied species. The specific name of tinctoria given by Roxburgh denotes its dye property as being then recognised, but in his *Flora Indica* he adds that "the root is said to dye red also."

The properties of both the dye and medicine are, at the present day, appreciated by the people in every province of India. It is mentioned in most of the Gazetteers and District Manuals, but the following special authors may be consulted regarding the substance:—

In Bengal, Roxburgh, Dutt, Gamble, Liotard, McCann; *in the North-Western Provinces*, Brandis, Buck, Atkinson; *in the Panjáb*, Stewart, Baden-Powell; *in Bombay and Sind*, Birdwood, Murray, Dymock, Lisboa; *in Madras*, Elliot, Moodeen Sheriff, Bidie, Drury; *and in Burma*, Mason, Kurz, &c.

The statement, made originally by Roxburgh, that the roots afford a red dye, has been confirmed by Schlich and by Kurz. All other writers, who allude to this subject, appear to have been compiling from Roxburgh, so that it would seem that the dye property of the roots is not generally known, or has, within the present century, been lost sight of, through the introduction of cheaper and more convenient dyes. A similar disappearance of knowledge has been incidentally alluded to above in connection with Bixa Orellana—a permanent dye having, according to Dr. Hove, been prepared in Bombay in 1787, through combination of the colour from the seeds with that prepared from the roots and leaves. *Kaméla*, he tells us, was employed to adulterate that permanent dye preparation from Bixa. But even at the present day certain writers speak of *Kaméla* as used to adulterate arnatto. It is thus probable that this practice was the outcome of the fact that the introduction of arnatto displaced *Kaméla*, the latter being continued as an adulterant only. Though much inferior to *Kaméla* in many respects, arnatto is a simpler and cheaper dye, eminently suited for temporary tinctorial purposes, such as the *Abír* of the *Holi* festival. The inference is thus probably admissible that *Kaméla* was the dye which Buchanan (*Statistical Account of Dinájpur*) informs us was displaced by the then recently introduced arnatto in the province of Behar. So far as the writer can discover, however, the dye property of *Kaméla* was at least not generally known in India much more than 200 years ago, and it seems highly probable that its medicinal virtues were not fully appreciated until a considerably later date. It is at least significant that painstaking investigators, such as Ainslie, Elliot, Roxburgh, Honigberger, and O'Shaughnessy, should have been ignorant of the fact (if fact it was, at the beginning and during the first half of the present century) that *Kaméla* was deemed by the people of India their most effectual anthelmintic drug. Ainslie does not so much as mention the plant by name, and Elliot and Roxburgh deal

MALLOTUS philippinensis. History of Kaméla.

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with it only as a dye; the former author informs us that with the Telegu-speaking people it was in his time known as wild-arnatto (*Kondu* or *Karujáphara*). Throughout India there is a singular tendency to give to the dye the vernacular names for the disease jaundice (*i.e., Kápila, Kamila, Kaméla, Khamalai, &c., &c.*), a comparison doubtless suggested from the resemblance of the dye to the jaundice skin. But a comparative name, such as the above, stands every chance of being of modern origin, the more so since four or five other silk dyes are nearly always confused with the *Kaméla* of more precise modern writers. Of these may be mentioned, **Calophyllum inophyllum, Crocus sativus, Mesua ferrea, Ochrocarpus longifolius.** The first is apparently the true *Pannága* of Sanskrit writers, though Roxburgh gave that synonym to **Mallotus**; so also the **Crocus** is the true *Kesar*, though that name is sometimes given to *Kaméla*. While such confusions exist, we have the assurance of Udoy Chand Dutt that the *Kampilla* and *Rechanaka* of the more recent Sanskrit medical writers was **Mallotus philippinensis**, and since it was by them recommended as an anthelmintic, it seems probable that his determination is correct, and consequently that the knowledge of this drug may have migrated from India to the Arabian and Persian physicians, and returned again when an import trade was established in the Ethiopian, Arabian, and Abyssinian drugs with which it became confused by modern writers. Flückiger & Hanbury (*Pharmacographia*), Bentley & Trimen (*Medical Plants*), and several other authors state that **Mallotus philippinensis** is a native of Abyssinia, Southern Arabia, and India. This is probably a mistake, the genus **Mallotus** being sparsely distributed to Africa. There are, however, three or four Abyssinian species and several members of allied genera, some of which appear to possess the medicinal properties of the *Kaméla*. At one time, for example, considerable interest was taken in *Cortex musenæ*, the bark of **Croton macrostachys**, *A. Rich.* (**Rottlera Schimperi**, *Hochst*), a tree met with in Abyssinia, which, by the natives of that country, is held in esteem as an anthelmintic. The frequent reference, by the older writers, to Abyssinian *Kinbíl*, leaves it probable that we shall yet discover that an African or Abyssinian species of **Mallotus** may actually have produced the drug in question, though modern writers assume that the Abyssinian supply must have been drawn from India. If this suggestion proves correct, the Indian knowledge in *Kaméla* may have been the result of an Abyssinian imported drug being recognised as identical with an indigenous substance not previously utilized.

The earliest mention of the anthelmintic drug *Kaméla* by European writers on Indian Economics appears to be the brief allusion to it in *Royle's Illustrations of Himálayan Botany* published in 1839 (p. 329), but it is noteworthy that he does not give it the name *Kaméla*, nor any form of that word. This is followed, however (in point of date), by Irvine (*Materia Medica of Patná*), who gives an account of **Rottlera tinctoria** which he calls *Kupíla*. He remarks: "The dust from the capsule of the fruit is used to dye silk yellow: considered as of a warm nature and given internally as an anthelmintic. Dose gr. ii to gr. v. Price per lb. Ro-3-0." In another page he describes **Daphne Mezereon** as *Kaméla* and says "the seeds imported from Kábul are used as an irritant." He again reverts to MEZEREUM, but calls it *Mameera* (*see Dict. Econ. Prod., Vol. III., 25*). Flückiger & Hanbury (*Pharmacographia*, 572) followed by Dymock (*Mat. Med. West India, 2nd Ed., 709*) and several other writers appear to be in error when they state that this drug is mentioned by Roxburgh and by Ainslie, but they are probably correct in assigning to Surgeon Mackinnon of Bengal the honour of having first (in 1858) sent it to Europe. Shortly after that date it was placed in the British and Indian Pharmacopœias, but it cannot be

said to have since made the same progress in Europe that it has done in India.

STATISTICS and PRICES. 73

Statistics and Prices of Kaméla.—With so extensive an amount of accessible literature as exists on the subject of *Kaméla*, it does not seem necessary that detailed information should, in this work, be given for each province. The tree is wild and apparently nowhere cultivated; the powder is obtainable in any local bazár and within easy reach of the chief seaports. If a demand were to arise, the supply might be almost indefinitely increased, without, for many years to come, necessitating cultivation. Though statistics cannot be given of the present Indian consumption or of the export, the writer, from personal knowledge of India, feels that he is within the mark when he affirms that considerably less than half the amount produced is at present utilised. It is quite customary to find, in the subtropical forests, miles of country, with here and there trees each bearing a mass of over-ripe powdery capsules, the *Kaméla* from which is simply being allowed to run to waste. Many writers allude to the extent of the local trade. Thus, for example, Mr. Atkinson informs us that 2,000 maunds are annually exported from Kumáon. The known extensive use of *Kaméla* as a silk dye is, however, a better criterion of the magnitude of the trade than the published statistics of any one district or province, since particulars of a limited number of districts only have been published, and the demand is for local rather than foreign markets.

The powder seems to vary greatly in price in the various districts of India: Dr. Dymock says that in Bombay it sells for R11 per maund of 41lb. Lisboa remarks: "If the berries be plucked too early, this dust (*Kaméla*) is mixed with another sort, of a greenish tint, which destroys the value of the article, and if not plucked at the right time, the dust will all disappear, being blown away by the wind, leaving the berries of a greenish-brown colour, and of no value. The article *Kaméla* finds a ready market, and is now worth one shilling and six pence a pound." Buck says that in the bazárs of the North-Western Provinces the *Kaméla* powder sells at R22 per cwt. The price in Bengal will be found, in the passage below, describing the process of dyeing which is pursued in the Lower Provinces. Regarding Nundydrug Division, Mysore, it is stated that one-eighth of the quantity produced is used locally, and that the average annual production is a little over 2 tons, and the average price R6 to R7 per maund.

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Chemistry of Kaméla.—*Kaméla* powder was first examined by the late Professor Anderson of Glasgow University, and subsequently E. G. Leube, Junior. The opinions originally published by these chemists have been reproduced in all subsequent medical works which have appeared in Europe, America, and India, without apparently any additional information being brought to light. The powder is said to be aromatic: is but slowly wetted by water and yields but litttle colour even to boiling water, colouring it pale yellow. In the presence of alkaline carbonates and caustic alkalies, especially the latter, it forms deep red solutions. The extract prepared with soda imparts to silk a fine and durable fiery-orange colour, without further addition or the use of mordants: with cotton, on the other hand, it does not produce a good colour. The natural dye stuff contains 3·49 per cent. water, 78·19 resinous colouring-matters, 7·34 albuminous substances, 7·14 cellulose, and 3·84 ash, besides small quantities of volatile oil and a volatile colouring matter. The liquid distilled from the alcoholic extract has a yellow colour, and the odour of the original substance. The concentrated etherial extract of the colouring matter deposits a yellow crystalline substance called *Rottlerin*. The extract, prepared with boiling alcohol, deposits, on cooling, non-crystalline flecks of a substance having the composition of $C_{20}H_{34}O_4$. It may be obtained nearly

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colourless, by repeated solution and separation; it is sparingly soluble in ether and in cold alcohol, insoluble in water; not precipitated by lead or silver salts. The alcoholic solution separated from these flecks leaves a dark-red resin, C_{30} H_{30} O_7, soluble in all proportions in alcohol and ether, insoluble in water, melting at 100°, and forming with acetate of lead, a deep orange-coloured precipitate of variable composition (*Anderson, as given in Watts, Chemistry*).

The authors of the Pharmacographia state, that so faras their experiments go, they have been able to confirm Anderson's results. They found that the resin was also soluble in glacial acetic acid or in bisulphide of carbon, but not in petroleum ether. The chemistry of the action of *Kaméla* as a purgative and anthelmintic does not appear to have been established: Anderson does not affirm that his *Rottlerin* is the active principle of the drug.

DYE. Kamela. 75

Process of Dyeing with Kaméla.—The brief account of the chemistry of this substance given above, expresses the rationale of its use as a dye. The ripe fruits are collected by the people, placed in a cloth or sac, and beaten until the glandular PUBESCENCE is removed from the exterior of the fruits. The powder thus obtained is then sifted to free it from the fruits and broken pieces, and in this condition it is ready for the market. The following account from Roxburgh's Coromandel Plants may be given in its original form. It conveys very nearly all we know on the subject, and has a historic interest as being the first account of the substance.

"The red powder, which covers the capsules, is a noted dyeing drug, especially among the Moors, and constitutes a considerable branch of commerce from the mountainous parts of the Circars. It is chiefly purchased by the merchants trading to Hyderabad and other interior parts of the Peninsula.

"When the capsules are ripe, or full grown, in February and March, they are gathered, the red powder is carefully brushed off, and collected for sale; no sort of preparation being necessary to preserve it.

"This substance like Annatto is difficultly acted on by water; it communicates no particular taste, either by infusion or decoction, and only a pale straw-colour, which acids scarcely alter, but alkales brighten and deepen. To spirits it very rapidly gives a rich, deep, flame-coloured orange, inclining to red. Alkaline salts enable water to extract a very deep blood-red, which, on agitation, produces an orange-coloured froth, and tinges the sides of the vial. Neither spirits nor alkaline solutions dissolve it, for the distinct minute grains of the powder are seen adhering, in their original state, to the sides of the vial, when shaken, but are now of a bright gold or orange-colour, about the size of very minute grains of sand: in this it differs widely from Annatto, which is soluble in both these menstruums. Alum, added to the alkalised infusion or decoction, renders the colour brighter and more permanent; tartar (to appearance) in a great measure destroys it, yet the mixture dyed white silk of a very beautiful colour, if possible, superior to any other I have tried.

"This red powder dyes silk a deep, bright, durable orange, or flame-colour of very great beauty. The Hindu silk-dyers use the following method:

"Four parts of *Wassanta-gunda*, one of powdered alum, two of salt of soda (native Barilla), which is sold in the bazárs, are rubbed well together with a very small proportion of oil of sesamum, so little as hardly to be perceptible; when well mixed, the whole is put into boiling water, proportionate to the silk to be dyed, and kept boiling smartly more or less time, according to the shade required, but turning the silk frequently, to render the colour uniform."

with Kaméla. (*G. Watt.*) MALLOTUS philippinensis.

Sir E. C. Buck (*Dyes and Tans of the North-Western Provinces, 31*) says, "The dye obtained from the fruits is used in dyeing silk and wool, giving a rich flame colour of great beauty and permanence. It does not require a mordant, all that is necessary being to mix it with water containing about half its weight of carbonate of soda. The dye was very favourably reported on by the jurors of the Madras Exhibition as being especially valuable for silk. The bark of the tree is used in tanning leather. It is imported into these provinces from the Sub-Himálayan forests and Calcutta, and sells in the bazár at R22 per cwt. When used it is simply pounded and dissolved in water." Colonel Beddome (*Fl. Silv., t. 289*) writes, "The red mealy powder of the capsules is a valuable product and might be a source of considerable revenue in many of our forest districts; it is used as an orange dye principally for silk. The ripe capsules are gathered in March and rubbed together or shaken in bags till the farina separates. It is known as *Kapli* or *Kaméla* powder." "The powder is much adulterated in our bazárs, but some collected carefully by the Forest Department realised a high price in the English markets." McCann gives (*Dyes and Tans of Bengal, 18*) the facts communicated, regarding the dye, to the Economic Museum by the various district officers of Bengal. The tree blossoms, he says, in the end of the autumn and the fruits ripen in January and February. From Bírbhúm the following report was received :—"Formerly *Kamalágurí* trees grew in abundance in Bhandibún and the adjacent villages, where the weavers were in the habit of paying a certain rent for them, but now they are not taken care of, and the weavers have given up dyeing *tasar* and silk." It would thus appear to have once upon a time been in a state of semi-cultivation in Bírbhúm. In Purí we are told by McCann the cost of collection of the powder is about R3 per maund, but in a table the selling price in six districts is shown as varying from R7 to R40 per maund. McCann then states, "the powder is only very sparingly soluble in either hot or cold water, but is completely dissolved in alkaline liquids, forming a dark red solution. The resinous yellow colouring matter may be separated from this red solution either by neutralising with an acid, or else by mere exposure to the air. In Bengal the red powder is dissolved by the addition of a solution of various alkaline ashes obtained by burning plants, and the development of the yellow colouring principle is in no case brought about by the addition of acids, but merely by allowing the cloth steeped in the red liquid to dry by exposure to the air. It is said not to require a mordant, but frequently alum is added for that purpose. The colour is sometimes heightened by the addition of turmeric."

SUBSTITUTES.—Atkinson (*Himálayan Districts, 776*) says the substances chiefly used to adulterate the powder are the pounded bark of Casearia tomentosa (the *chíla* of Garhwál) and a powder prepared from the red fruits of the banyan tree (Ficus bengalensis). On the other hand, he adds, *Kaméla* powder is itself used to adulterate annatto dye. In some districts *Kaméla* is always used in combination with annatto, the one being supposed to strengthen the colour of the other. Wardle, in his recent Report on the Dyes of India, remarks that the colours produced by *Kaméla* are fast; it promises to be a very valuable dye-ware. (See Mr. Wardle's statement regarding the superiority of *kaméla* over that of *wars* as a silk dye in Vol. III., 402, of this work.)

TAN. Bark. 76

Tan.—The fact that the BARK is used as a tan has been incidentally mentioned above. This is referred to by Atkinson (*Himálayan Districts, l.c.*), Buck (*Dyes and Tans, North-Western Provinces, l.c.*), by Kurz (*Forest Flora Burma, l.c.*) and others. Professor Hummel of Leeds was, however, furnished with a sample from the Colonial and Indian Exhibition, and in his report on the same states that the bark was but a poor

tanning material, possessing only 6·5 per cent. of tannic acid which imparts a deep reddish colour.

OIL. 77

Oil.—The SEEDS yield a bland oil which many writers recommend as worthy of investigation. It has not apparently been chemically examined, but it is used medicinally by the people of India.

Seeds. 78

MEDICINE. Kamela. 79

Medicine.—From the brief historic account given above, it will be seen that the early Arabian writers on *Kinbíl* spoke of it as being applied externally in certain skin affections, or as being taken internally to cure leprous eruptions. The distinction into *wars* and *kaméla*, the latter being defined as an anthelmintic, was not made by the Arabs until about the tenth century. In the seventeenth century, Rheede, the first European writer who in India described the drug, was apparently ignorant of any special merit possessed by the powder, but spoke of the PLANT as being employed in the preparation of a cataplasm which was found useful for external application. It was not, indeed, until well into the nineteenth century that the merits of the *Kaméla* powder were recognised.

Plant. 80

From about 1780 to 1840 might be described as a period of earnest investigation into, and record of, the vegetable resources of India. In the field of research Jones, Roxburgh, Ainslie, Buchanan, Elliot, Honigberger, O'Shaughnessy, &c, worked and published their results. No mention is, however, made by any of these authors of the anthelmintic property of *Kaméla* powder, though they were all apparently familiar with the dye which it yielded. But, from the close of the period named, writers from every province, indeed almost from every district, speak of the anthelmintic property of the drug, as if this knowledge had been a matter of ancient history. It is impossible to believe that all the distinguished authors mentioned could have overlooked so important a subject, but it is equally difficult to credit so sudden an evolution on the part of the people of India. It seems much more likely that modern authors have compiled from one to two sources and that the anthelmintic drug, even at the present day, is more known to Government apothecaries than to the rural populations of India. The Rev. A. Campbell, who for many years has patiently devoted himself to the study of the Santals and made an admirable collection of all the plants, wild and cultivated, which are found in their country, says of Mallotus philippinensis:—"The fruit yields a red powder which is used as a dye and medicine, as also the bark. From the seeds a medicinal OIL is prepared" Honigberger mentions the plant as used in "anorexia, fever, giddiness, hemiplegia, hepatic and thoracic pains," but makes no mention of the specific property of the powder—the property which alone is dealt with by modern writers. Indeed, the use of the LEAVES, FRUIT, and BARK in the preparation of external applications, such as those described by Rheede, seems to have disappeared from modern Indian works, its place being taken by the undoubtedly more important property of an anthelmintic. Apparently, however, in Europe and America, *Kaméla* has gained some reputation as an external application in the treatment of itch, and the advocates of this use of the drug generally urge that it is extensively so employed in India. The writer can find no record of this being the case. Dr. Dymock (*Materia Medica, Western India*), for example, contents himself with giving a review of the drug (mostly compiled from Flückiger & Hanbury), and says practically nothing of its special applications in Western India except that it is viewed as an anthelmintic. Waring in his *Bazár Medicines* gives the chief facts regarding its value as an anthelmintic and describes the methods of usage:—"In medicine, the purplish-red powder has attained considerable repute as a remedy for Tænia or tape-worm. It has little or no effect on other forms of intestinal worms. The dose for an adult is from 2 to 3 drachms in honey, or a little aromatic water, no other medi-

Oil. 81

Leaves. 82

Fruit. 83

Bark. 84

MEDICINE.

cine being necessary before or after. In the above doses it acts freely on the bowels, causing, in many instances, considerable nausea and griping, though not generally more than is caused by other remedies of the same class; the worm is generally expelled in a lifeless state in the third or fourth stool. Should the first trial not prove successful, it may be repeated after the interval of a week, but should this be a failure also, it will be useless to continue its use further; other remedies may then be tried." Garrod found "its active purgative properties at times rather objectionable" (*Mat. Med.*, *313*). In most European and American works it is stated that the powder has been long used in India in the treatment of tape-worm. From what has been said it will be observed that the writer does not think the literature of the subject fully bears this out, and, indeed, with a large section of the people of India (the higher caste, vegetarian, Hindus) a drug which has its specific action on tape-worm was not likely to have been in much demand. The *United States Dispensatory* assigns to the RESIN extracted by ether, the active properties of the drug. Royle seems to have thought its action was mechanical, resembling that of cow itch (Mucuna pruriens). This opinion appears to have depended upon the microscopic structure of the grains. Their peculiarities have been thus described by Flückiger & Hanbury:—"The granules of *Kamala* are irregular spherical glands, 50 to 60 mkm. in diameter; they have a wavy surface, are somewhat flattened or depressed on one side, and enclose within their delicate yellowish membrane a structureless yellow mass in which are imbedded numerous, simple, club-shaped cells containing a homogeneous, transparent, red substance. These cells are grouped in a radiate manner around the centre of the flattened side, so that on the side next the observer, 10 to 30 of them may easily be counted, while the entire gland may contain 40 to 60."

Resin. 85

SPECIAL OPINIONS.—§ "There can be no doubt that it is *Kaméla* that has been generally employed in all Government Hospitals as it is supplied from the Saharanpore Botanical Gardens, and the Mallotus philippinensis is so common everywhere in the neighbouring Himálayan hills that there would be no object in adulterating it or substituting anything for it. There can be no doubt as to its efficacy as a purgative and anthelmintic in tænia" (*Brigade Surgeon G. A Watson, Allahabad*). "Purgative and anthelmintic in doses of half drachm to one drachm" (*Assistant Surgeon Shib Chunder Bhuttacharji, Chanda, Central Provinces*). "I have often found a two-drachm dose of *Kaméla* to be an efficient medicine in expelling tœnia, and it is not so nauseous to the taste as the extract of male-fern" (*Surgeon-Major H. W. E. Catham, M.D., M.R.C.P., Lon, Bombay Army, Ahmednagar*). "*Waras* when applied externally, either mixed with water or oil, has a protective influence on the skin against dry and cold winds" (*Surgeon-Major Jayakar, Muskat*). "A commonly used anthelmintic. Uncertain in adults. Is also laxative" (*Assistant Surgeon Nehal Sing, Saharanpur*). "*Kaméla* powder is an efficacious anthelmintic, and its efficacy is increased when given along with purgatives in doses of from ʒiss. to ʒii" (*Assistant Surgeon Ram Chunder Gupte, Bankipore*). "Powder is anthelmintic, vermifuge, and cathartic, dose ʒi; externally used in scabies" (*Bolly Chand Sen, Teacher of Medicine*). "Used at the Civil Hospital, Umballa, Panjáb, as an anthelmintic. Can be obtained in the bazárs here" (*Brigade Surgeon R. Bateson, I.M.D., Umballa City*). "Ointment made of the powder (ʒi to ℥i) is used for skin diseases" (*Surgeon Anund Chunder Mukherji, Noakhally*). "Anthelmintic, purgative; doses ʒi to ʒii; used in tape-worm" (*First Class Hospital Assistant Choonna Lal, City Branch Dispensary, Jubbulpore*). "Is not to be compared with either santonin or male-fern" (*Surgeon-Major*

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E. Sanders, Chittagong). "A very inferior anthelmintic, not to be compared to santonin" (*Surgeon G. Price, Shahabad*).

Structure of the Wood.—Smooth, grey to light red, hard, close-grained, no heartwood. Annual rings indistinct. Pores small, uniformly distributed, scanty, often sub-divided. Faint indications of transverse bars. Weight 48lb per cubic foot. The wood warps and shrinks and is not used except as fuel.

87 **Mallotus Roxburghianus**, *Muell. Arg.; Fl. Br. Ind., V., 428.*

Syn.—ROTTLERA PELTATA, *Roxb.; Wight, Ic., t. 1873.*

Vern.—*Kamli mallata, phusri mallata*, NEPAL; *Nim pûteli*, BENG.; *Sirgúllum*, ASSAM.

References.—*Roxb. Fl. Ind., Ed. C.B.C., 737; Kurz, For. Fl. Burm., II., 383; Gamble, Man. Timb., 361.*

Habitat.—A small evergreen tree or shrub found in the Sikkim Himálaya, in Sylhet and Assam, in the Khásia Hills, Chittagong and the Martaban, ascending to 2,000 feet.

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Structure of the Wood.—White, moderately hard, close-grained. Weight 46lb per cubic foot.

MALT LIQUORS.

89 **Malt Liquors.**—Under this head it is designed to give as concise an account as possible of the progress which the brewing of Malt Liquors—such as Ale, Beer, and Porter—has made in India and also to refer briefly to the indigenous processes by which exhilarating or intoxicating malt beverages are prepared by the people of this country. It may be explained that the portion of the article on the ancient history of the art of brewing, as here given, has been mainly taken from the pages of the *Encyclopædia Britannica*, and the Indian facts (on European Breweries) from a paper published by Mr. H. Whymper on 'Brewing in India' which appeared in *A. Boake & Co.'s Diary for the Brewing Room.*

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EARLY HISTORIC FACTS REGARDING MALT LIQUORS.

All countries, whether civilised or savage, have, in every age, prepared an intoxicating drink of some kind. The art was known and practised by the Egyptians many hundreds of years before the Christian Era, and afterwards by the Greeks, Romans, and ancient Gauls. In the second book of Herodotus, written about 450 B.C., we are told that the Egyptians, being without wine, made wine from corn. Pliny also informs us that they made wine from corn, and gave it the name Zythum. Hellanicus, speaking of the introduction of wine at Plinthium, a city of Egypt, states: "Hence the Egyptians are thought to derive their love and use of this liquor, which they thought so necessary for human bodies, that they invented a wine made from barley." The Greeks obtained their knowledge of artificial fermentation from the Egyptians, at a very early period. We find it mentioned, for example, in the writings of Archilochus, the Parian poet and satirist, who flourished about 700 B.C., that the Greeks were already acquainted with the art. Again, we learn from Æschylus (470 B.C.), from Sophocles (420 B.C.), and Theophrastus (300 B.C.), that the Greeks employed barley wine or beer (their Zythos) in daily life as well as at festive meetings. There is, in fact, little doubt that the discovery of beer and of its use as an exhilarating drink was nearly as early as that of wine. Xenophon, in his account of the retreat of the ten thousand, written 400 years B.C., mentions that the inhabitants of Armenia used a fermented drink made from barley. Diodorus Siculus states that the Galatians prepared a fermented beverage from barley, which they called *Zythos*, like the Egyptians. In the time of Tacitus

History of Malt Liquors. *(G. Watt.)*

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(whose treatise on the manners and customs of the Germans was written in the first century of the Christian Era) beer was their usual beverage, and from his description, imperfect as it is, there can be no doubt that they understood the method of converting barley into malt. Pliny mentions its use in Spain under the name of *Celia* and *Ceria*, and in Gaul under that of *Cerevisia* or *Cervisia*. He says:—"The people of Spain in particular brew this liquor so well that it will keep good a long time. So exquisite is the cunning of mankind in gratifying their vicious appetites, that they have thus invented a method to make water itself produce intoxication."

The *Cervisia* of Pliny evidently takes its name from Ceres, the Goddess of corn. Plautus calls it *Cerealis liquor*, that is, liquor used at the solemn festival of that goddess. Beer and vinegar were the ordinary beverages of the soldiers under Julius Cæsar. From them the Britons are supposed to have learnt the art of brewing. Beer being so suitable to the climate of Britain, and so easily made by an agricultural people with plenty of corn, it was gladly welcomed and soon became the favourite beverage. After the departure of the Romans from Britain, the Saxons subdued the natives and learned from them the art of brewing.

Malt Liquors of Aboriginal Races.

Dr. H. Mann tells us that the Kaffre races of South Africa have made for ages, and still make, a fermented drink like beer from the seed of the millet (**Sorghum vulgare**), which is subjected to a process of malting in all essential particulars identical with our own. The natives of Nubia, Abyssinia, and other parts of Africa, also make an intoxicating drink of great power, called *bousa*, from the flour of the *teff* (**Poa abyssinica**) and from the *durrha* or millet, much esteemed by the natives, and preferred by many to palm or date wine, the common intoxicating drink in tropical countries. According to Mungo Park, the natives of Africa also make a beverage from the seed of the spiked or eared soft grass (**Pennisetum typhoideum**). The Russian drink *kwass* or *quass*, a thick sour beverage, not unlike *bousa*, is made of barley and rye flour, mixed with water and fermented. Formerly, the spruce-fir, birch, maple, and ash trees were tapped, and their juice used for beer-making in England, the first two, indeed, up to the last fifty years. *Koumiss*, the drink of the Tartar race, is fermented mares' milk. The Chinese malt beverage, *samshee*, is made from rice, and a similar liquor is prepared in Japan also from rice, known as *sake*, which is almost identical with the *Zu*, rice beer, of the Angami Nagas (*Conf.* with *Vol. II., 260*) and the *pachwai* of India generally. The Kakhyans prepare their *sherú* from rice. The Lepchas, Lushais, as well as the Nagas, make a rice beer in which apparently the fermenting agent is spontaneously generated. The hill men of the Simla neighbourhood expose rice or maize water, flavoured with some bitter principle and spices till fermentation sets in. The Burman *congee* is a beer which the Khyens and Karens also use. In fact, throughout India a crude beer (*pachwai*) is prepared and was probably known from ancient times (*Conf.* with the account of Soma, *Vol. III., 246-251*). The process of manufacture is of the most primitive kind. The ingredients are generally some fermentable substance such as malt from millet (*paisht*), from rice, barley, wheat, &c., or from the fruits or flowers of certain plants, particularly *Mahuá*, **Bassia latifolia** (*see Vol. I., 406-415*); **Eugenia Jambolana** (*see Vol. III., 286*); **Melia Azadirachta**—the *Nim* tree (*see p. 211.*); from dates, raisins, or other less important substances (see the article **Yeast**, *Vol. II, 259-260*). But by far the most prevalent Indian beverage is *tari* or toddy made from palm juice, *nim* or sugar-cane,—see **Borassus, Caryota, Cocos, Melia, Phœnix**, also the article **Narcotics**, &c.

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Most of the Indian beverages are flavoured with drugs, often highly pernicious, and they are fermented by various substances (*see Vol. II., 259-260*). Harmless spices are also frequently added to flavour the liquor, or, as in the case of the *Zu* beer of the Nagas and the *Marwá* of Sikkim, a warm infusion from grain is consumed before fermentation has been established (*Vol. II., 260*). In the majority of cases the infusion is exposed in a warm place, for spontaneous fermentation; but the use of a special ferment, such as the common yeast of brewers and that too preserved in cakes (*see Vol. II., 257-260, also Vinegar, Vol. I., 72-77*), is not unknown.

History of European Brewing in India.

The history of the manufacture of malt liquors in India, is, to some extent, the history of a series of unsuccessful efforts at establishing an exotic industry, in a country then unfavourably placed for its prosperity as a remunerative enterprise It is only within recent years, as a consequence of the growth of large European communities and the existence of army contracts, given out by Government to the Indian brewers, that the industry has at last been able to firmly establish itself in this country.

The pioneer brewer in India appears, says Mr. Whymper, to have been a Mr. Henry Bohle, who commenced business at Meerut and Mussoorie in 1825. His attempts were, however, very disappointing, and in 1852 his business passed into the hands of his partner, Mr. John Mackinnon, the founder of the firm of that name now in Mussoorie. It was not, however, till about the year 1870 that success dawned upon the enterprise. In the meantime, between the years 1850 and 1860, several small breweries were opened in hill stations, most of which operated but for a short time and then failed. In fact, it may be said that one only, of the early breweries of Northern India has survived. It was started at Kussowlie by Captain Bevan, who, in 1854, finding it a fruitless enterprise, disposed of his interest to Mr. Dyer. The concern thereafter passed into the hands of a Company, and subsequently was bought by Mr. Meakin, who still retains an interest in it and has made it a success.

In 1860, a brewery on a more pretentious scale was started by Messrs. Conill & Hay in Simla. The lines on which it proposed to work may be said to have foreshadowed its failure. Even the bricks, which were employed in the construction of the buildings, were imported from England at an enormous cost. Expenditure on other branches of the concern were equally reckless, and the business closed and finally passed into the hands of Mr. Meakin. Balfour (*Cyclopædia of India*) says that in Southern India Captain Ouchterlony initiated the industry about 1850. He failed, and was followed by Mr. Honeywell, who may be said to have carried on the business ever since. A curious experiment, Mr Whymper tells us, was made at Bangalore not long after, *viz.*, to manufacture beer from imported concentrated wort, but it is probably needless to add that this venture also proved a failure. It would be beside the purpose of the present article to refer to the establishment of each and every brewery in India. Suffice it to say that there are now 25 breweries at work, of which 20 have been established since 1870, and of these 12 have sprang into existence within the past ten years (1879-89). This progress may be still further exemplified by the figures of outturn. In 1881 some 21 breweries were working and these produced 2,448,711 gallons, of which the Commissariat Departments purchased 1,764,927 gallons. During the succeeding eight years (1882-89) the production and Government purchases rose steadily until, in 1889, the figures stood at 5,165,138 made in India and 3,778,295 gallons purchased by Government. In the

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previous year the Government purchases of Indian beer amounted to 4,628,175 gallons.

Of the 25 breweries at work during 1889 the following were the more important:—

The Murree Brewery Co., Limited, at Murree (1,148,949 gallons), at Ráwalpindi, 205,632 gallons, at Ootacamund (336,558 gallons), at Bangalore (267,408 gallons), with smaller concerns at Quetta and Ceylon: Meakin & Co. at Poona (501,816 gallons), at Kasauli (450,000 gallons), with smaller breweries at Chakrata, Darjíling, Dalhousie, and Ranikhet. Dyer & Co. at Lucknow (340,038 gallons), at Mandalay (232,804 gallons), at Solon (133,272 gallons): Mackinnon & Co. at Mussoorie (183,591 gallons); also the Orown Brewery Co. carrying on business at Mussoorie (411,183 gallons) and the Naini Tal Brewery Co., at Naini Tal. The total outturn for the year was returned at 5,165,138 gallons.

Mr. Whymper, in concluding his historic sketch of Indian breweries, remarks:—

"There are few Indian, or Native, breweries in the Mysore State. They are of slight consequence. About 1875 a brewery was started at Bandora near Bombay. The peculiar feature of this establishment was that tidal water was used in brewing. This water was frequently quite salt and the beer was very nauseous; it however kept sound in a most remarkable manner. The beer was sold for some time in Bombay.

"The brewery, which works most satisfactorily, under the most trying conditions to be met with in India, is said to be that at Dapooree, near Bombay. This belongs to Messrs. Meakin & Co. The writer visited this brewery on the 22nd April 1886 The temperature of a well-shaded verandah at 8 that morning was 93°; at noon it was 106°; the brewery office at the same time was 100°. By using a five-ton ice machine as much as possible, the average pitch heats had been about 75° in that month. Nothing had been pitched under 72°. One gyle had to be pitched at 88°, it rose to 101°, at which the attemperators were able to hold it. Beers, brewed under nearly the same unfavourable conditions three months before, were examined and were perfectly sound to the palate. The writer is fully aware this will not receive ready credence in England. The owner, Mr. H. G. Meakin, is an elder brother of the Burton maltsters, and possesses an unusually venturesome spirit which has so far carried with it well-merited success.

"It must not be supposed that all brewers have anything like such unfavourable conditions to contend with as Mr. Meakin has had. The majority of Indian breweries are situated in the mountains of Northern India, or of the Madras Presidency. There is one brewery at Lucknow which has only a very short winter, but still it does have some cold weather, whereas the Dapooree one has none. The breweries in the Northern Hills (as the mountains are always called) have cold winters, some have as much as six months' good brewing weather, and Messrs Mackinnon are so well situated that they can brew sound beers all the year round. The breweries in the Neilgherry Hills in Madras, and the brewery in the Ceylon Mountains, both being at an elevation of over 6,000 feet, can also brew every day in the year for export trade. The trade of the latter is principally with Lower Burma. Sir Samuel Baker was the pioneer brewer in Ceylon, but it is doubtful if he ever foresaw that Ceylon would eventually have an export beer business. The Murree Brewery Co. purchased the present brewery site from a German firm which did not succeed in brewing to meet the public taste.

"The brewery at Quetta has, perhaps, the most extraordinary climate of all Indian positions, the sun being so intensely hot, even in the winter months, that a brewer has to wear a sun helmet whilst at the same time he

has to clothe himself in a fur-lined coat to protect himself from the biting cold which there is in the shade. Whilst prospecting for a brewery site, the servants of the Company suffered from both sun and from frost-bites. The cold which is occasionally experienced is too great to make it safe to employ much steam power, and although the Company, in the first instance, erected a steam plant, it had to be replaced by the open boiling system; pipes, pumps, and injectors, steam pressure gauges, and of a blow-off cocks were all frozen up, and burst in the most impartial manner."

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MATERIALS AND METHODS OF BREWING.

Few industries can be said to have been more directly benefited by the chemist than that of BREWING. It is by no means the case, however, that all brewers adopt in their entirety the principles enjoined by chemical research. In many minor details they follow empirical laws and claim merit in certain processes, the knowledge of which they alone possess. The main facts of the chemistry of brewing will be found under Vinegar—Acetum—(*Vol. I., 72-77*), *viz.*, the transformation of insoluble starch, contained in grain, into soluble saccharine compounds. The methods by which this is accomplished in India and the subsequent fermentation, together with the details of brewing, that can be viewed as in any way peculiar to this country, will be found very briefly detailed below. This subject may be discussed under the headings of the chief materials used, *viz.*, Grain, Hops, Yeast, and Water.

Grain. 90

I.—THE GRAIN.

Barley is, of course, the grain employed in India. The following account of it is taken from Mr. Whymper's paper:—"The barleys used by the Indian brewer are entirely grown on the Peninsula. The breweries in the South imported Persian grain and English malt until very recently, but now northern barleys are carried down and malted at the breweries. The range of Indian barleys is considerable, and the quality varies to a great extent. Grain weighing nearly fifty-two pounds to the bushel is grown as far south as 24° north latitude. The best grain, however, is found about 28° north latitude, in the North-West Provinces, and extreme South Panjáb, where fifty-six pounds weight to the bushel is procurable. In Northern India a curious custom prevails of cutting the whole crop down to the ground when about to throw into ear. Cattle are fed on the green stuff so cut, and the barley is allowed to grow again, and, strange to say, it does not seem very much worse for this treatment. In the hills in Madras two crops a year are grown, but the grain is hardly ever allowed to ripen properly, and, consequently, occasions malting difficulties. Barley has been grown in Ceylon and used in brewing, but it is not likely to be permanently grown there, not being a sufficiently valuable crop. All Indian barleys require more warmth and moisture in malting, especially if grown on irrigated soil, than European barleys. Maltsters in England have complained of Indian barleys not germinating freely. It is open to question whether they have sufficiently allowed for the fact that they are dealing with grain grown under totally different conditions to that which they have been usually accustomed to malt. It should be remembered that Indian barley which would find its way to Europe is seed from an almost semi-tropical plant, and naturally requires much more warmth and coddling than English barley. It should be kept up to 60° in the cistern and kept thick on floors. It will not be injured by warmth when growing. The great drawback to its use is the large quantity of weevil found in some samples. The Indian crop is cut at varying dates, according to latitude, from March to May. The hot weather then sets in

and the grain undergoes a hot summer season and several months of monsoon weather before it is malted. The contrary holds good in England, where barley after harvesting is stored in cold weather until required for malting. The spread of weevil in Indian samples is thus very understandable. Natives believe that weevil will never be found in old buildings to the same extent as if stored in new granaries, and they attribute this entirely to the dampness of all new buildings. The writer believes there is something in this view, from facts which have fallen under his notice. There can be no doubt that the quantity of weevil can be minimised by shipments being made to England in June and July, and by great care being exercised in storing the grain in very dry places. Sun kills weevil."

Mr. Whymper has obligingly furnished for this work the following additional facts which in some respects supplement the passage quoted :— "Indian Barley, from growing in a warmer and drier climate than in England, requires more warmth in the malting process and less water than in England. Generally speaking, Indian barleys germinate more freely than English, French, or Belgian. I do not know of any other difference. There is no doubt Indian grain would be improved if zemindars could be induced not to cut the crop down for green fodder.

"Chevalier barley seed was given away freely by the Murree Brewery Co., in the Hazara District about 1870 and in the Nilgiris in 1887-88, but with poor results. The following localities produce very good malting barleys :—Hazára, Ludhiána, Delhi, Rewari, Fazilka in the Pánjab; Allahabad, Mirzapur in the North-West Provinces; but ordinarily good barley can be procured almost anywhere in the Panjáb and North-West Provinces, and in parts of Rájputána. Bombay and Madras Presidency Breweries are supplied from the North. Indian Barley varies in weight from 46 to 56lb per bushel."

The barleys of the Panjáb and North-West Provinces are fairly well adapted for brewing purposes, but it is generally found that the percentage of "extract," as compared with English grain, is below the mark. This has been traced to many causes :—Poor seed, unfavourable soil, the objectionable practice of preserving the grain in cow-dung, cutting down the crop for green fodder, and causing it to spring again and yield its grain, exposure of the grain to severe atmospheric changes, careless handling in packing and transit; these and many other defects tend to lower the value of Indian barley for the maltster. But perhaps the most pernicious practice of all is traceable to the middleman, *viz.*, the adulteration of new grain with old, the mixture being sold as fresh stock. When this is done, the brewer has no end of trouble and often heavy pecuniary loss owing to irregularity in germination.

In concluding these remarks regarding barley suitable for brewing, the following useful passage from *Spons' Encyclopædia* may be quoted as giving the English experience :—"The selection of the barley used by the brewer calls for the exercise of much skill and judgment; unless the quality be of the very best, it is impossible to obtain good malt, and without good malt, it is useless to attempt to make good beer. A practised brewer can judge of the quality of his barley by its appearance. The heaviest, if in good condition, is always the best, the grains should be plump, and of a pale-yellow colour; they should have a thin skin, and a free, chalky fracture. That which has been grown in a light soil and harvested early, is also preferable. It is of much importance to the malster that barley be lodged in the stack for a few weeks before being thrashed, in order to allow the moisture from the soil to dry off before it comes into his hands. If this is done, the operation of drying in the kiln is avoided. In moist districts, however, where the grain never gets thoroughly dried, this process must invariably be had recourse to; the temperature of the kilns must never be

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allowed to arise above 50° (120° F.). Care must be taken to avoid breaking or crushing the grains of malting barley, so as to minimise the chances of its becoming mouldy in the subsequent processes of malting, a contingency which should be avoided in every possible way. It should also be screened before steeping, in order that the grains may all be of equal size on the spiring floor. These remarks, of course, apply only to the brewer who is, as he ought always to be, his own maltster."

Hops. 91

II.—Hops.

Before fermentation hops are added to the wort, because beer made from barley alone has little or no flavour. Under **Humulus Lupulus** (Vol. IV., 302) will be found full particulars regarding the efforts which have been made in India to introduce the cultivation of this plant. It need, therefore, be only necessary to discuss here the qualities of imported hops that are in demand for the Indian breweries and the dangers to which stock is liable. There are known in trade two chief kinds of hops—red and green, the former being that most prized. The green is more easily grown, but does not possess the rich aroma of the red, and has, on the contrary, a more or less pronounced garlic-like smell. The distinction into red and green hops is not, however, always sharply defined, and, according to some writers, these properties are more due to care in culture and preparation, or to climate and soil, than to any racial distinction. Certain regions, for example, enjoy an exceptionally good reputation for cultivating hops, and, consequently, the name of the country of production often passes muster for the quality of the article.

The following are the principal kinds of hops known to Indian trade:—

Austrian. 92

Austrian.—Bohemia is the principal hop-cultivating province of the Austrian crown lands. The hops of the district of Saaz, which are of the red variety, are universally preferred.

German. 93

German.—Bavaria is the principal hop-cultivating country of the German Empire. The hops from Spalt (city and country) are most prized.

English. 94

English.—The hops of Kent, Sussex, Hereford, Hants, Worcester, and Surrey, are not an especially fine but very productive article.

American. 95

American.—The centre of the hop, cultivating district is Utica, in the State of New York. Both varieties are grown and are rising in favour.

Hops, as an article of commerce, occupy a very peculiar position. On the one hand, the yield varies very much from year to year; on the other, they cannot be stored like grain, for instance, without injury to their value, and therefore must be consumed as quickly as possible.

Hops are very liable to deterioration in the variable temperature of India. On this account special precautions have to be observed in packing and storing them. The influences which exert an injurious effect upon the quality of hops are moisture and atmospheric air. Several methods have been recommended to protect hops from these evils. Smoking with sulphur was once much in vogue and still is to some extent; but it is considered by experts to be of doubtful advantage by itself. Combined with pressure of the hops within an air-tight receptacle, it has been found to answer admirably. A double packing cloth is used, and in addition the bales are covered with varnished paper or enclosed in well-soldered tin or pitched wooden boxes.

Speaking of Hops Mr. Whymper (in the paper already alluded to) says:—"The hops used in India are nearly all imported, for, although there are hops growing in Kashmír and in Kúlu, the quantity as yet offered has been small. Some very fair quality hops have been grown by a Major R. Rennick in the Kulu Valley, and he is persevering with the

growth. Australian hops are very serviceable, as they are picked about April and can be used in India early in June, thus supplying a new hop when most wanted." In reply to an enquiry as to the hops most generally used in India Mr. Whymper writes:—"I am not aware that any Indian brewers have a particular preference with regard to hops. All use various kinds or, in other words, "blend" various kinds in order to get regularity of flavour as is customary in England. The dry climate of India naturally tells against hops stored in this country, and the Indian brewers cannot thus safely hold very large stocks."

For further information regarding hops, the reader is referred to the article **Humulus Lupulus**, Vol. IV. 302. Also instructive papers in the Jour. Royal Agri. Soc., England, Vol. VII (1846) Chemistry of Hops, 210; IX (1848), Hop Culture, 532—582; XIV (1878), 723—736.

III.—Yeast and Fermentation.

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An interesting paper on the fermentation of brewing was read by Mr. T. F. Garrett at the Brewers' Congress which was held in London during 1887. The discussion which followed the reading of that paper also considerably amplified the facts laid before the Congress. Space cannot be afforded to quote very freely from Mr. Garrett's paper, which, as he claimed, was a popular *résumé* of the discoveries in connection with the fermentation of brewing, but the following passages are more especially interesting. Mr. Garrett traced the development of our knowledge of the subject from the discovery made by Lavoisier in 1788 that sugar was broken up, during fermentation, into alcohol and carbonic acid. He then dealt with the modifications accomplished in 1825, by M. Caignard-Latour, in the discovery of the yeast cells, and concluded with a sketch of the perfection of the theory and science of fermentation as brought about by Pasteur. Mr. Garrett alluded to Pasteur's discoveries in the following concise passages:—"The scientific genius, whose name is so familiar from his investigations in the matter of hydrophobia, started with Caignard-Latour's discovery of the growth of yeast in fermentation, and he, too, submitted yeast cells to close inspection under a powerful lens. He then subjected yeast to the addition of a solution of plain sugar and water, with the result that, although it began to grow at first, it soon left off and began to wither away—a kind of fermentation going on all the time; the yeast, therefore, must have been living upon itself. It was evident that the yeast contained in itself an element of its own nourishment that sugar did not, and this element he had no difficulty in deciding to be nitrogen. To the plain sugar solution of the previous experiment he then added ammonia, which contains a large proportion of nitrogen, and, with a satisfactory confirmation of this theory, the yeast grew and flourished amain, the sugar broke up into alcohol and carbonic acid gas, and the process of fermentation went on so long as any sugar remained to be broken up, or any nitrogen for the food of the yeast.

"He now turned his attention to the wort. That contained a nitrogenous substance in the shape of albumen, gluten from the malt, besides mineral salts and other not less important matters; and the discovery of these mineral salts, I may observe in passing, induced him to add some of them to the original ammoniated sugar and water solution, with the result that the yeast was decidedly more active and thorough in its work than it was without them. These mineral salts were the same as those usually found in hard or spring water, hence the very natural deduction that hard water was favourable for brewing—a discovery that brewers have not failed to adopt to their own uses where required, and to the improvement of their productions.

MALT Liquors

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"Thus far we have learned that, during a satisfactory fermentation, sugar is divided into alcohol and carbonic acid gas—the former remaining in the mass and the other being given off; and we also have learned that this action is in some way associated with the presence of yeast and its active growth, and that this plant requires a nitrogenous substance for its development."

"Let us now leave wort to itself, without adding yeast. Will it ferment? Certainly not. The juice of the grape and other fruits will, and so [illegible] certain other vegetable juices, but not wort. It will undergo a ci[illegible] though a rapid change a change of decomposition, if you will; but [illegible]nade *alcoholic* fermentation. The result will not give carbonic acid and [illegible] (Vol. but other offensive gasses; it is *putrefaction*, and that you can tell b[illegible] have nose. The early addition of yeast prevents this process of putrefac[illegible] need, leads the decomposition into another and pleasanter channel, but [illegible]ed hops have not failed to take advantage of this to declare that fermenta[illegible] to which putrefaction are in a measure the same. That is, however, an ar[illegible]ops—red shall not enter into here, for, unhappily, we are fast emerging [illegible]more easily *simplicity* of the process, into a wild, confusing and chaotic [illegible]d has, on the tradictory discoveries, or shall we say flights of scientific ima[illegible]he distinction will require all our tact and discretion to avoid. We must [illegible]ed, and, ac- grains of corn from the chaff for ourselves, in the absence of [illegible]h culture and great pioneer. [illegible]on. Certain

"There are many fermentations, all of which have some [illegible]r cultivating common, but which, nevertheless, differ so materially from ea[illegible] often passes I must be excused if I do but give you their names. They are [illegible] *dalous* fermentation, *butyrous* fermentation, *gallous* or *tann*[illegible]n trade:— *mucous, pectous, saccharous, sinapous, urinous, viscous*; and, of co[illegible] of the ancient and respected *acetous*. If chemists are only as energetic and e[illegible]f the siastic upon the subject of fermentations as they were a very few years [illegible] the chances are that there are great many more fermentations inventc[illegible] th now, and so I shall be pardoned perhaps if I invent one—a name [illegible] mos though—for our own particular use. Alcoholic fermentation is termed vin which applies to wine and beer alike. I should like to call that 'beerc[illegible] and which applies to beer. However, as I do not wish to offend the ears of [illegible] term chemical friends that may be present, we perhaps had better adher[illegible] the 'alcoholic.'

"As I said before, these numerous fermentations have some features [illegible]n common, but in their actions, complications, and productions they diff[illegible]r, widely from each other. It is my conviction that Pasteur intended to ex[illegible] mine each individual fermentation by itself, but that as fast as he took away one head to examine it a hundred others cropped up; so that it is not to be wondered at if he has been scared, by this Hydra-fermentation, and taken to Hydrophobia as a relief. But he did much good service in the subject before he associated his great name with rabid rabbits and mad dogs, and we have every reason to be thankful to him for it.

"In the limit of this paper it would not be possible to treat individually of this vast assemblage of different fermentations. Our immediate interest is confined to the fermentation of beer, and even then we must admit of at least two *opposed* kinds, and they are *alcoholic* and *acetous* or vinegar fermentation.

"We go back to the yeast and the wort, and must take it for granted that the materials provided are good, that the wort is amply saccharine and the yeast the scion of a healthy stock; and I may mention here, that there are described by various chemists nearly a hundred varieties of yeast, due possibly more to circumstances than to breed. Two at least are known to you—the *high* and the *low*—and these may vary greatly according to the acciden-

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tal conditions of their life and growth. Of the bitter wort we need take no further notice than to state that to its existence, purity, and the slight changes it undergoes are, in a measure, due the aroma and flavour of the beer.

"That the yeast should be healthy is very important, for the health of the beer depends upon it. Yeast is a very deteriorating stock, unless preserved in its pristine vigour by good management and good wort; should it be found to be weak or sickly, it should be discarded or sold to the bakers, who are not so particular as a rule, for it is better to part with a little yeast at once than spoil a whole series of brews. Once in possession of a goodly stock of yeast, take care that you keep it. Never mix inferior yeast with it, for you will not improve the bad, but will certainly weaken the good. Neither can inferior yeast be improved by working in strong or extraordinarily good wort. But above all things, keep your yeast from contact with unclean vessels, or anything, I need scarcely tell you, that has the slightest vinegar taint.

T. "We know that *alcoholic fermentation* in wort results from the addition of yeast. Without the yeast we have nothing better than putrefaction."

"Now what are the conditions most favourable to the growth of yeast? *Suitable food, warmth, and air.* Of the food and warmth we will speak presently. What about the air? Some chemists doubt if yeast does require air for its development; but other chemists have settled that point to their satisfaction. When the yeast is in the tun with the wort the carbonic acid gas that is given off lies above the wort and forcibly keeps the air from any further contact, but there comes along the brewer with his ranser, and he gives fresh energy to the yeast. But does he do this by mingling air with the wort? The processes that wort usually goes through before the yeast is added are all calculated to introduce air, and perhaps there may be some air with the yeast, at any rate we have confirmation, of its influence when admitted.

"If a bottle of freshly made wort be boiled so that all the air it contained is driven out, and then hermetically sealed in an atmosphere of carbonic acid gas, such as may be found in any fermenting tun at work, we have, to all intents and purposes, a bottle of wort with which atmospheric air is not in contact. Into this sealed bottle, by a very simple process, yeast can be introduced without air and then the opening be sealed up again. Fermentation is set up and goes on, but the yeast does not thrive; it rather withers away. Admit air *instead of yeast*, and a change slowly sets in that is not alcoholic fermentation. The liquid becomes cloudy, muddy, and eventually gummy and ropy, for a form of decomposition has set in, and a mould forms on the surface. But how did the germs get into the bottle? They must have been imported by the air, for had the air not been introduced into the hermetically-sealed bottle, no change would have taken place for generation after generation. The bottled wort would have kept as well as bottled fruit, or tinned milk, meat or vegetables. What did the yeast, then, introduce?

"Pasteur had the natural curiosity to ask himself that question, and moreover he endeavoured to answer it. Placing a drop or two of the discoloured fluid under the lens of his microscope, what did he see? I must not tell you now; but it was a sight that held him fascinated and spell-bound with wonder and admiration. It was the great secret revealed—the secret that generations of chemists had failed to discover.

"The experiment was repeated again and again, always with the same result—the yeast would not decompose without the air and the same astonishing changes took place; the introduction of yeast *after clouding had set in* was too late to save the beer, for instead of flourishing, as it should have

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done, it yielded sway to the stronger power of putrefaction, or other mischievous fermentation that was now set up, and virtually gave up the ghost. How was this? The explanation is at hand.

"Next, air was passed into the bottle that had passed through asbestos, or a plug of cotton wool, and no change took place in the wort, or only a very little; but when air *unhindered* was admitted, the same decomposition set up in due course. Now, what had this asbestos or cotton wool arrested on the road? Evidently, the germs of decomposition. So Pasteur placed that under his lens, and then he saw, adhering to the wool, a number of little bodies. To these he added fresh wort, and, to his delight, they filled out and immediately became *plants and living creatures!* just the same, in fact, as those he had seen before in the decomposing wort.

"Here we have the great microbe discovery—the greatest discovery of the age, although it is microscopic.

To the presence of these germs Pasteur was quite entitled to ascribe the process of decomposition, fermentation, or putrefaction; the microbes of yeast, he ascertained, were quite distinct in character from those of putrefaction, and those of acetous fermentation, he showed again, were different from either of these, and all were different from each other.

"This microbe question is undoubtedly a great discovery, but how, or in what manner, they effect the various changes that they invariably attend requires much further investigation. That they are very materially concerned is shown by the fact that if wort be boiled, that is, raised to the boiling point, and then subjected only to air that has been heated to redness, so that all microbes are destroyed, no changes of ferment or putrefaction set in."

"The influence of air in the process of fermentation is interestingly shown if yeast be added to fresh wort in an open shallow vessel. This process is then excessively rapid. The rate of decomposition is intensified. The sugar is more speedily consumed by combustion, and then about 25 per cent. of the sugar is used by the yeast, leaving rather less than three-fourths of its quantity to be converted into alcohol and carbonic acid, and the product is proportionately weak, and, therefore, very liable to be overcome by acetous fermentation or putrefaction. Under ordinary circumstances only 5 per cent. of the sugar should be unconverted, leaving 95 per cent. to be converted into alcohol and carbonic acid—a great and fatal difference, because the presence of alcohol hinders putrefaction, and its absence permits it.

"Yeast, like every other plant or growing thing, requires warmth for its development; therefore it is arranged that, by the very process of breaking up the sugar, heat shall be evolved, some of which the yeast requires for the gentle nurture of its progeny or young cells, and the balance remains with the wort, and becomes sensible to the thermometer.

"If the sugar breaks up, or *burns* too fast, an excessive growth of sickly hothouse yeast follows as a matter of course; or if you prefer it, I will reverse the order of expression, and say that if the yeast grows so rapidly that the sugar is broken up by its agency too fast, then the sugar is extravagantly wasted in the process and less alcohol results."

"Again, yeastic fermentation must not be too slow or too long delayed in being set up, or other ferments which are not alcoholic will take the place of the yeast, having been imported by the air or utensils, and the two the brewer has most to fear are either vinegar germs or perhaps putrefaction. Therefore, the brewer has quite enough to do to steer and maintain his balance between the rocks and quicksands. Let him once disregard the one or the other, and damage to the beer ensues.

"But the brewer regulates all this in his own way, and I doubt if we can teach him any better. He watches the indication of the thermometer, for full well he knows that anything unusual about that tells of something wrong with the brew. If the temperature be too high, the process is too quick and he fears the weakening result of excessive combustion; if too low the process is too slow and weak, and he has visions of vinegar fermentation. It is not my province to speak of practical brewing. You, gentlemen, are better able to cope with that subject than I; my task is to speak of the principles of fermentation as applied to brewing, and so we come back once more to the consideration of the yeast.

"The food for yeast is found in the nitrogenous substances provided by the malt, which are extracted by spurging, and it is important that this should exist in the wort in sufficient quantity to feed the yeast so long as there is sugar to be broken up. Should the nitrogenous matter be in excess, the yeast will go on devouring it at the expense of the alcoholic strength. Should the nitrogenous matter be exhausted before the sugar is consumed, the process is arrested too early, also at the expense of alcoholic strength, and either of these causes will affect the stability of the brew. Doubtless you have your remedies for these defects, based upon strictly scientific principles, confirmed by practical experience, so that I need not touch upon them. But how does the yeast effect its work? It is by actual contact with the sugar, for if a solution of ammoniated sugar-water in a bladder be suspended in working wort, it is absolutely unaffected. The mystery has not yet been quite satisfactorily explained, beyond that previously suggested by the law of affinity; the bonds of the sugar's combination of elements are loosened by the agency of the ferment, so that we must leave the further consideration of yeastic influence to the future, when something more shall be credited to the scientific labours of our genuine working chemists."

During the discussion which followed the reading of Mr. Garrett's paper on fermentation, the chairman at the meeting, Mr. H. Whymper, drew attention to the remark which had been made that malt wort if left to itself undergoes no alcoholic fermentation. As bearing on this subject, Mr. Whymper mentioned a discovery made by him, *viz.*, that barley dust would, however, establish fermentation in the wort, and hence in his opinion the outer coat of the grain bore the microbe necessary; in other words, it afforded, as he called it, "the seed of a wild yeast." This statement was confirmed by Mr. L. Briant, who on procuring barley under such circumstances as to remove any suspicion of yeast derived from a malt house obtained the ferment from its dust. Several gentlemen, present at the conference, stated that this was no new discovery, that it had been observed by several brewers before, but that no importance had been attached to the fact. The subject would, however, seem, as Mr. Whymper affirmed, to be of the very greatest interest, since it has been customary to suppose, grapes, apples, and one or two other fruits, peculiar in that they carry the mycrobes necessary for their own fermentation. Mr. Whymper's observation shows that this is not confined to such fruits, but that it exists with barley. And the writer would add, not with barley only, but very probably with many other grains, since the rice and millet beers made by the people of India are all known to become alcoholic if left to stand for a few days. Thus the Angami Naga rice beer which for the first three days, after the hot water has been poured over the grain, tastes like butter milk, in a day or two undergoes fermentation and becomes powerfully intoxicating. But, besides this fact, many plants are known in India to possess the direct power of establishing vinous fermentation in saccharine fluids. These, like the barley alluded to by Mr. Whymper, doubtless bear microbes, the na-

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ture of which has not as yet been investigated. Thus, for example, Mr. C. B. Clarke pointed out that the Khásia Hill people were able to procure fermentation from the flowering spikes of Rhyncospora aurea, a cyperaceous plant found plentifully in that region. The writer, during a journey in Manipur, found that the powdered stems of a climber (probably a Millettia), mixed with rice flour and made into cakes, were similarly employed to establish fermentation in rice wort (*Conf.* with Vol. II., 259). It need only be added that other examples might be given, sufficient to justify the suspicion that the *tari* or palm juice so largely used in India as a source of yeast may become spontaneously charged with the germs of vinous fermentation.

The choice of yeast and its treatment for future use are of great importance. If the brewer desires a favourable course of fermentation he must first of all set the wort with good yeast. It may, indeed, be said that out of a hundred cases of defective fermentation ninety-nine can be traced to the bad quality of the yeast. Good brewing yeast is that which thrives best at a low temperature. The deterioration of yeast in this country is due to the high temperature at which fermentation has to be carried on, especially in the plains. A free use of ice would mitigate the evil; but at the same time it would seriously increase the selling price of the beer.

The Indian brewer has often on this account to propagate his exotic yeast in the cool climate of the hills and send to the plains supplies as required at the breweries. The result of this treatment is that the plant is in a constant state of deterioration and a continuous fresh supply from Europe becomes necessary.

Mr. Whymper has kindly furnished the author with the following instructive reply to the enquiry regarding yeast: —"Indian brewers now very generally preserve yeast by drying it with charcoal powder. It only requires to be mixed with the charcoal and dried at a moderate heat. In this condition it will remain active for many months. This system has not been many years in use. Prior to my knowing of it, I used, when possible, yeast preserved in plasters of sorts. Mr. Percy Adams of Halstead, Essex, preserves good yeast made up in small marbles. Formerly I used dessicated yeast made up with powdered plaster-of-paris. This never gave such good results as the solid balls. But these methods of preservation are not absolutely necessary, as yeast can be produced in India. I can now undertake to start a true alcoholic fermentation in malt wort by the mere addition of the dust from the skin of barley. It may be said that it is now accepted that the dust or bloom of barley contains germs of several ferments."

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IV. – Water.

In the passage quoted above from Mr. Garrett's paper, which was read before the Brewers' Congress, reference has been made to Pasteur's discovery of the advantage of mineral salts in the water of the wort, fermentation being more vigorous and thorough in its operations. Commenting on this fact Mr. Garrett added that brewers had not failed to adapt to their own use the advantages thus demonstrated of a hard over a soft water, such as that to be obtained from wells or springs. The following passage from *Spons' Encyclopædia* gives the most prevalent ideas regarding the water suitable for brewing:—"A constant unfailing supply of good water is indispensable in brewing: though what really constitutes good water is a point upon which many brewers and chemists have long been at issue. Some rest their faith upon a soft water, others will use only the hardest water they can get, while others, again, are quite indifferent, and will use either. It is now, however, a generally accepted fact that water for brewing should not contain organic matter, but a considerable quantity of inor-

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ganic or saline constituents; these varying in nature and quantity, according as the beer to be made is required for keeping or for immediate consumption. English brewers are now agreed that the water should contain much carbonate and sulphate of lime. The former of these two ingredients is the most necessary, but they should both be present in the water from which ale is to be made; water used in brewing porter may contain the carbonate alone. For the best ales, the proportions seem to be from 10 to 20 grains a gallon of each. The excellence of the ales made by the Burton brewers is doubtless due to the quality of water used by them; it is very hard, and contains, as will be seen from the analyses given below, a large proportion of alkaline sulphates and carbonates, this is the best argument that can be brought forward in favour of the use of hard water. The supply is derived entirely from springs, and not, as some suppose, from the river Trent. It has also been urged, as an advantage, that hard water increases the quantity of saccharine matter held in the wort, thus heightening the flavour and preventing it from becoming acid." The following table represents two analyses of the water used by the Burton brewers:—

Two Analyses of Burton Water.

	(1)	(2)	
Chloride of sodium	10·12	...	grains a gallon.
Sulphate of potash	7·65	...	,,
,, lime	18·96	54·40	,,
,, magnesia	9·95	0·83	,,
Carbonate of lime	15·51	9·93	,,
,, magnesia	1·70	...	,,
,, iron	0·60	...	,,
Silicic acid	0·79		,,
Cholride of calcium	...	13·28	,,
	65·28	78·44	

Mr. Whymper has obligingly furnished the writer with the analyses of some of the principal waters used by Indian breweries. These have been made by Government analysts and can, therefore, be depended upon as accurate. Space cannot, however, be afforded for the publication of these in this work, but in purity from organic and other injurious materials they are second to none, while they possess the necessary amount of salts to render them good brewing waters. Thus the water used by the Crown Brewery Company contains 46·62 grains of inorganic salts to the gallon. The proportion of these salts varies slightly; in one of the returns they amounted to only 41·8640 grains per gallon, the sulphate of magnesia being 14·06, carbonate of magnesia 7·57, sulphate of lime 8·78, and carbonate of lime 6·46.

Most of the Indian breweries use spring water filtered and boiled before being used.

V.—Malting.

The first stage in brewing is that by which the grain is converted into malt. This technically is known as Malting and it consists of *steeping*, *couching*, *flooring*, and *kiln-drying*. In these various stages the grain is made to germinate and when it has reached the desired degree its further growth is arrested by the *kiln* heat. The chemistry of this operation has already been alluded to, namely. the conversion of the insoluble starch of the grain into a saccharine soluble materials. But it is not necessary to deal in this work with each of the stages of malting, since they are in India identical with those pursued in Europe.

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This comprises the stages known as *grinding*, *mashing*, *boiling*, *hopping*, and *cooling* and afterwards of *fermenting*, *cleaning*, and *storing*.

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But as with MALTING it may be said that the Indian brewers follow closely on the lines of their European contemporaries and that they employ the same materials, machinery, and appliances.

The following information furnished by Mr. H. Whymper will, however, be read with special interest as giving facts of an Indian nature:—"The brewing season for nearly all Indian breweries is restricted by the short Winter. In Ootacamund the temperature allows brewing to be carried on all the year round, but elsewhere the season is from October to March. The worts are cooled in the ordinary manners first by exposure on shallow vessels termed coolers and thereafter by flowing over ordinary refrigerators through which cold water flows. Cellars are cooled by being left open in the coldest weather. No artificial means of cooling has yet been adopted, but the largest brewery (that recently erected at Rawalpindi) is now constructing powerful ice machinery for cellar cooling.

"The class of beers, &c., made in India is practically the same as in England, more light gravity beer is consumed, however, than in England. Wood is almost invariably employed as fuel except for drying malt on kilns when charcoal is used.

"Labour is much more expensive than in England (*a*) from the large number of men required to do the simplest job, (*b*) from the careless and indifferent manner in which work is done, and in which machinery is treated."

Pasteurisation.—"This process only applies to bottled beers. There is no known practical process of pasteurising beer in wood. Indian brewers generally are now adopting this process which consists merely in immersing beer when bottled in cold water and raising the temperature gradually by the injection of steam, until it reaches 135° to 140° Fahr., at which temperature it is maintained for about half an hour. By this process all germs which would ordinarily incite fermentation of sorts (vinous, lactic or hectic) are destroyed. As bottled beer ordinarily depends upon a fermentation in the bottle to obtain its briskness (otherwise its carbonic acid gas) and as no such fermentation takes place with pasteurised beer, it is necessary to bottle beer, which is to be pasteurised, highly charged with gas. Theoretically such beer should remain without change for ever, and practically it does remain sound for very much longer than it ordinarily would."

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VII.—BARRELS, VATS, BOTTLES, CORKS, &c.

Before proceeding to discuss the trade in Beers and Ales, it is necessary to say something about the construction of beer-barrels, &c. The barrels or casks used in the breweries of this country are almost without exception constructed of oak, and are either made up in India from rough staves imported from the Baltic, or imported in shook, *i.e.*, bundles from London and remade in this country. Several attempts have been made to utilise the indigenous timbers of this country for barrel-making, but the extensive and various forests of India have failed up to the present moment in producing a wood good enough to replace the English or European oak. Sál (Shorea robusta) has been tried with some success in the construction of vats. White cedar from the Malabar Coast makes a good-looking vat, but its use is somewhat dangerous in consequence of the absorbent nature of the wood rendering it very liable to crust. The English oak would find a strong competition in the Indian Ash and Teak if the former could be got in larger quantity and the latter at cheaper rates. Deodar, and the wood of pines generally, impart their resinous properties to the beer. The brewers of India are very anxious to find a wood which would successfully compete with the expensive and indispensable English oak, but hitherto the efforts to find such a timber have been unsuccessful. The valuable characteristics of oak are its freedom from knots, its density,

durability, and lightness. It is also non-absorbent and thus not liable to impart its resin to the beer.

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BOTTLES are purchased in the country. Mr. H. Whymper experimentally manufactured bottles at Jhelum from local materials for some time, but was unsuccessful and accordingly abandoned the enterprise. CORKS are all procured from England. BREWER'S GRAINS, that is, refuse malt, is usually sold by contract to zemindars or cattle owners, and in most cases is easily disposed of, but the price obtained fluctuates with the value of the fodder crop.

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Mr. H. Whymper in his article on *Brewing in India* gives the following historic sketch of the trade in imported beer in this country :—"What was termed country-brewed beer was very generally made in India at the close of the last century and early in this. This is said to have consisted of about one-fifth of a bottle of porter (English), a wine-glassful of toddy or palm juice, some ginger and brown sugar, a squeeze of lime completing the ingredients. The toddy itself supplied the fermenting power and when this mixture had slightly fermented it was considered fit for use. This drink was in vogue when a London brewer, Hodgson by name, about the year 1816, began to ship a well-hopped and rather heavy beer to India. It quickly became known as India pale ale, and Hodgson speedily acquired a complete monopoly of the Indian trade. Until 1825 or 1826 he held the Indian market at his mercy, and his mercies were cruel. He kept out rivals at times by lowering his rates below cost price, and having stopped other brewers' shipments, up his prices went. It is reported that on more than one occasion he suddenly raised his price to £20 per hogshead. In 1824 he advanced to £24 per hogshead and refused all credit. The result was what he might have foreseen, a revolt of all interested in the beer trade taking place. This was about 1825. Very shortly after this we find the beers of Bass, Allsopp and 'Ind & Smith' in the market against Hodgson, and by 1840 his beers were only a memory.

"There is no doubt in the writer's mind that had the early shippers only kept up the quality of their beers, the whole of the Indian trade might have been in their hands at this moment. Although plenty of good beer went out, the general quality almost invariably fell off or failed to meet the public taste after a few shipments. Occasionally such bad beers were in the market that it was inevitable people should say : 'Well, if we can't get better beer than that we might as well brew our own, as we couldn't possibly brew worse :' this certainly occasioned at least one essay in the early days of Indian brewing. The shipments of beer for the use of the army were not a very great, if any, exception to this rule. Plenty of good beer went out, but, every now and then, the Government was startled by thousands of hogsheads of beer proving so bad that they had to be run into the nearest sea or river. It was thus no peculiarly favourable local circumstances which caused the rise of the brewing industry in India. There are no such circumstances, there are difficulties which every English brewer who goes to India looks upon at first as insuperable; but beers which did not meet the public taste and were inferior and bad, coupled with high prices, gave the Indian brewer his chance. All that the Indian brewer has in his favour is being nearer to the markets he sells in. Against this he has endless difficulties; he has to import and order, and often pay for ahead, his hops, casks, machinery; he has to keep in reserve duplicates of everything likely to break down. He has to import all his supervising staff of servants; if he gets an unsuitable man he has to put up with him. His most serious difficulty is, that owing to the above circumstances and from

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having to do all his own malting, he has to employ three times the capital he would have to do in England for a similar trade to his own."

"The writer's experience," continues Mr. Whymper, "does not go back beyond 1866. In that year, and for several years after, the declared quantity was about 200,000 barrels; it is now about 60,000 barrels. The value was then about £600,000, and it now averages about £200,000. The quantity of beer brewed in India in 1866 was probably not more than 2,500 barrels, certainly not more than 3,000, whilst in the present year it will possibly reach to 170,000 barrels and will certainly be over 150,000 barrels. The limit of the whole trade to be done with the European population of India is probably 250,000 barrels."

"The trade will not likely expand beyond this until the Government relaxes certain rules, which, whilst they restrict the sale of beer in some districts, unquestionably foster the consumption of spirits. In Southern India, for instance, the brewer is not allowed to brew beer for native consumption above a certain alcoholic strength, and this strength is not sufficient for the native palate."

Turning to the official records of the BEER TRADE the following table may be given of the foreign beers brought into India. It will be observed that the imports fell off steadily from 1866 to 1878-79, but that from the latter date they have since steadily improved, until, at the present time, they are nearly as large as they were prior to the existence of Indian breweries:—

*Import of Malt Liquors from Foreign Countries.**

Years.	Gallons.	R
1866-67	Not given.	55,20,245
1867-68	2,268,298	43,57,701
1868-69	1,816,106	38,17,734
1869-70	1,898,762	41,35,199
1870-71	1,642,131	31,16,860
1871-72	1,499,877	30,53,186
1872-73	1,536,496	36,34,956
1873-74	1,435,345	33,79,155
1874-75	1,481,698	34,98,438
1875-76	1,143,157	26,81,065
1876-77	1,176,922	27,06,644
1877-78	1,328,077	31,30 700
1878-79	1,080,211	24,45,685
1879-80	1,065,347	25,42,620
188 -81	1,152,678	28,40,349
1881-82	1,199,395	28,46,121
1882-83	1,170,554	27,23,226
1883-84	1,261,444	30 32,236
1884-85	1,066,913	24,99,272
1885-86	1,299,418	30,06,098
1886-87	1,715,638	35,40,257
1887-88	2,138,518	39,71,534
1888-89	2,398,580	41,28,517

If to the imports of last year be added the amount of beer made in India during the year 1888-89 (*viz.*, 5,165,138 gallons), the total consumption in India must have been for that year 7,563,718 gallons, fully three times as much as in 1866. For further particulars regarding the trade in Malt Liquors the reader is referred to the article Narcotics, section MALT LIQUORS, pp. 328—330.

hili. valuat.

* Conf. with table on p. 329.

The Common Mallow. (*G. Watt.*) MALVA sylvestris.

MALVA, *Linn.; Gen. Pl., I., 201.*

Malva parviflora, *Linn.; Fl. Br. Ind., I., 321;* MALVACEÆ. 105

Vern.—*Nárr, panirak, supra, sonchal, nanna, gogi ság,* PB.

References.—*Stewart, Pb. Pl., 23; Murray, Pl. and Drugs, Sind, 57; Pharmacogr. Indica, 228; Gasetteers:—N. W. Provs., IV., 68; A., 306; Journal, Agri.-Horti. Society XIV., 7; Indian Forester, VIII., 177.*

Habitat.—A small, spreading herb, found in the North-West Himálaya (altitude 1,000 to 2,000 feet), also in Upper Bengal, Sind, and the Panjáb. Distributed through Europe, the Levant, Arabia, and Nubia.

Medicine.—The SEEDS are used as a demulcent in coughs and ulcers in the bladder. MEDICINE. Seeds. 106

Food.—Frequently eaten as a POT-HERB by the Natives, specially in times of scarcity. FOOD. Pot-herb. 107

Domestic.—In Kanáwar the ROOT is used by women to cleanse their hair; woollen cloth is also washed with it. Bellew states that the root is employed as *rísha khatmí* (*see* Althæa rosea). DOMESTIC. Root. 108

M. rotundifolia, *Linn.; Fl. Br. Ind., I., 320.* 109

Syn.—M. VULGARIS, *Fries.*

The *Flora of British India* describes two varieties under this species:—

Var. 1, borealis: Bengal: Mysore.

Syn.—M. ROTUNDIFOLIA, *Roxb.;* M. BOREALIS, *Wallm., et Boiss.;* M. ROTUNDIFOLIA, *var.* β in *W. & A. Prod.;* M. PARVIFLORA, *Huds.*

Var. 2, reticulata: Bengal and N.-W. Himálaya.

Syn.—M. ROTUNDIFOLIA, *var.* α in *W. & A. Prod.*

Vern.—*Sonchala, khubasi,* HIND.; *Kúkerai,* PUSHTU.; *Chandiri, khabasi* (seed and fruit), SIND; *Trikála malle,* TEL.

References.—*Elliot, Flora Andh., 184; Aitchison, Botany Afghan Delimitation Commission; Murray, Pl. and Drugs, Sind, 58; Atkinson, Him. Dist., 306, 741; Gasetteers:—N.-W. Provs., IV., 68; Mysore and Coorg, I., 56.*

Habitat.—A much branched spreading herb found in the North-West Provinces, Kumáon, and Sind. Distributed through Europe and Western Asia.

Medicine.—The SEEDS possess demulcent properties. They are prescribed in bronchitis, cough, inflammation and ulceration of the bladder, and in hæmorrhoids; they are also externally applied in skin diseases. The LEAVES, being mucilaginous and emollient, are employed as an external application in scurvy; they are also reckoned useful in piles. MEDICINE. Seeds. 110 Leaves. 111

Food and Fodder.—In some parts of Sind, the LEAVES are eaten as a pot-herb. The SEEDS are also reported by Mr. Lace to be eaten by the people of Quetta, and the PLANT used as fodder for cattle. FOOD & FODDER. Leaves. 112 Seeds. 113 Plant. 114 115

M. sylvestris, *Linn.; Fl. Br. Ind., I., 320.*

THE COMMON MALLOW.

Vern.—*Viláyati-kangai, gúlkheir,* HIND.; *Khatmi* (PATNA), BENG.; *Kanji, tilchuni,* N.-W. P.; *Gul-i-khadmi,* AFG.; *Khabájhi,* SIND; *Khubasi,* BOMB.; *Vilayati-kangói,* DEC.; *Khubasi, khitmi,* ARAB.; *Khubás, towdrie, (nán-i-kulágh*=crow's-bread, *khitmi-i-kuchak*=small-khitmi), PERS NOTE.—It will be seen from the remarks below that all the provincial names for this plant that have been derived from the Persian *Kangai,* or *Kangoi,* and hence probably refer to Abutilon.

References.—*Honigberger, Thirty-five years in the East, 304; Aitchison, Botany Afgh. Del. Com., 43; Ainslie, Mat. Ind., I, 205; O'Shaughnessy, Beng. Dispens., 214; Moodeen Sheriff, Supp. Pharm. Ind. 19, 170; Dymock, Mat. Med. W. Ind., 2nd Ed., 80; S. Arjun, Bomb. Drugs, 18; Murray, Pl. and Drugs, Sind, 58; Year Book of Pharm., 1874, 115, 623;*

MALVA sylvestris. The Common Mallow.

1878, 288; Irvine, Mat. Med. Patna, 49; Pharmacog., Ind., I., 204; Atkinson Him. Dist., 306, 741; Birdwood, Bomb. Pr., 10; Royle, Fib. Pl., 263; Gazetteers:—Mysore and Coorg, I., 58; Agri.-Hort. Soc. Ind. Journal, XIV., 15.

Habitat.—An erect, nearly glabrous herb, met with in the Western Temperate Himálaya, from Kumáon, at an altitude of 2,500 feet, to the Panjáb and Kashmír. Distributed to Europe, Northern Africa, and Siberia.

FIBRE. 116

Fibre.—The plant abounds in fibre (*Royle*).

MEDICINE.

Medicine.—Most of the MALVAS contain much mucilage and have demulcent and emollient properties, but **M. sylvestris** perhaps enjoys the first rank as a medicinal species. To a large extent it takes the place, in Asiatic pharmacy, which **Althæa officinalis** (the Marsh Mallow) holds on the Continent of Europe. It appears to have been known to the early Muhammadan physicians, who probably derived their knowledge of it from the Greeks. The early Sanskrit medical writers do not seem to have placed much importance on malvaceous mucilaginous preparations. The modern Hindu doctors, however, following perhaps the Muhammadans, prescribe such preparations, but having adopted tropical substitutes for Malva, have caused a certain amount of ambiguity in their restricted application of vernacular names to the plants so employed. **Dr. Moodeen Sheriff** writes under **Abutilon indicum**—the COUNTRY MALLOW of popular writers:—"The word *kanghí* or *kangóí* is not only used incorrectly in some books as synonymous with the Arabic and Persian words *khabbázi*, *khitmi*, *tódarí* (*the names of three different drugs*), but is also confounded with the word *kangóní* or '*Coongoonie*' as it is generally written. The latter is one of the Dukhni synonyms of the seeds of **Setaria italica**" (*Conf. with Dictionary Econ. Prod., I., 14—17*). **Dr. Moodeen Sheriff** recommends that when these words are used to denote **Malva sylvestris** *var.* **mauritiana** (the Bengal and Western India form of the species), the prefix *viláyatí* (=foreign) should be given, thus *viláyatí-kangóí*. According to **Moodeen Sheriff**, therefore, **Abutilon** is the true *kanghí* of India, and the association of that name with **Malva sylvestris** would therefore be incorrect. This may be so, but it is more likely that *kanghí* has a generic and medicinal signification, denoting the mucilaginous **Malvaceæ** rather than any one species of **Abutilon** or **Malva**. At all events, the confusion that has arisen, is in the application of that name and its synonyms to closely allied plants which all possess the same or nearly the same properties. The *balá* of Sanskrit writers was a cooling preparation made, apparently, from the roots of various species of **Sida**. In the Pharmacopœia of India the mucilaginous substitute recommended for mallow is made from **Hibiscus esculentus**. This is described as a valuable emollient and demulcent, also diuretic. Of the same nature are the preparations, used by the people of India, made from **Corchorus** (see Vol. II, 540 and 543).

Birdwood suggests that **Malva sylvestris** is probably the μαλαχη χερσατα (Malakhí) of **Dioscorides**, which was known to the Egyptians as *Khokorteen*. But **Alpinus** figures and describes **Corchorus** as Melochia. **Dymock**, accepting the same rendering, remarks that "the Mahometans probably derived their knowledge of its medicinal properties from the Greeks. **Mauluna Nafí** describes three varieties, *viz.*:—

1st—A cultivated kind called *Malokia*.
2nd—A large wild kind called *Khitmí*.
3rd—A small wild kind called *Khubází*.

The author of the *Makhzan-el-Adwiya* pronounces the last mentioned to be the article now known as *Khubází*."

Plan. 117

Dymock adds that "all parts of the PLANT are commended in Muhammadan works on account of their mucilaginous and cooling properties, but

The Officinal Mandrake. (*G. Watt.*) MANDRAGORA microcarpa.

the FRUIT is considered to be most efficient." Irvine speaks of the SEEDS as generally employed, the dose being in infusion ʒii to ʒ ss. Honigberger remarks "the seeds are used by the Hakims in cough, and ulceration of the bladder." Commenting on the nature of the *tódarí* seeds of the bazárs he says there are two kinds, the white (the seeds of **Polyanthes tuberosa**) and the coloured (the seeds of **Malva sylvestris**). From the passage quoted above it will be seen that **Moodeen Sheriff** dissents from the opinion that *Tódarí* is a Persian synonym for *Khubází*, and **Dr. Dymock** has determined the Persian seeds imported at the present day into Bombay under the name *Towdrí* to be those of **Lepidium iberis**.

MEDICINE. Fruit. 118 Seeds. 119

Ainslie says that "the Hindu doctors prescribe the expressed JUICE, internally, in gonorrhœa, and give an infusion of the ROOT as a drink in fevers." From the fact, however, that **Ainslie** speaks of the plant, to which he refers, as being very common in South India, growing by road-sides and having yellow flowers, it seems probable that he refers to **Abutilon** and not to **Malva**. The LEAVES of **Malva sylvestris** are generally reported to be employed in the preparation of an emollient cataplasm. **Murray** writes that the plant is largely used by native drug-sellers in the formation of a decoction which contains in addition to **Malva**, rose petals and sugar-candy. This is said to be prescribed in strangury. The mucilaginous property of the plant is found beneficial as an external application in irritation of the skin, and a poultice of the leaves is sometimes employed in fomentation, very much after the same manner as Marsh Mallow is used on the Continent of Europe.

Juice. 120 Root. 121 Leaves. 122

Trade.—The fruit is imported from Persia into Bombay under the name *Khubází:* it is worth about 4 annas per pound (*Dymock*) Irvine (*Mat. Med. Patna*) says that in his time it sold at 5 annas a pound.

TRADE. 123

Food.—Was eaten by the Romans as a vegetable, and where it occurs in India it is also eaten by the people like most other species of Malva.

FOOD. Plant. 124

Malva verticillata, *L.; Fl. Br. Ind., I., 320; Wight, Ic., t. 950.* 125

Syn. M. NEILGHERRENSIS, *Wight.;* M. ALCHEMILLÆFOLIA, *Wall.*

Vern.—*Laffa*, ASSAM.

References.—*N.-W. P. Gazetteer, X., 306; Proceedings of the Rev. & Agri. Dept, Agri. File No. 6, Serial No. 28 of 1888 (condition of the People of Assam).*

Habitat.—An erect annual, or perennial herb, in the temperate Himálaya (ascending from 6,000 to 12,000 feet), from Assam and Sikkim to Kumáon and Lahoul. It is found in the cornfields of the Nilghiris. Distributed through Europe, Abyssinia, Egypt, Amoorland, and China.

Food.—This HERB is grown in patches on homestead land in Assam, where it is a very general custom among the natives to boil the leaves and tender shoots, and eat them as spinach with rice.

FOOD. Herb. 126

Manalú Oil of Kanara is said to be used for lamps. The plant which yields this oil is not known. 127

Mandioca or **Manioc Meal**, see **Manihot Glaziovii**, *Müll.*, p. 157.

MANDRAGORA, *Juss.; Gen. Pl., II., 900.*

Mandragora microcarpa, *Bert.*, SOLANACEÆ. 128

THE OFFICINAL MANDRAKE.

Vern.—*Luckmuna, luckmunie, lufah*, HIND.; *Yebruj*, BENG.; *Kaat-júti*, TAM.; *Loofahat*, MALAY.; *Ustrung, serag-al-coshrob, ussul-ul-lufah* (root), *lufah*, (plant), *tufah-ul-shitan* (fruit), ARAB.; *Yabroox, merdumgeeah*, PERS. The above vernacular names are given on the authority of **Sir George Birdwood's** *Bombay Products*, 61; also **Irvine's** *Mat. Med. Patna*, 61.

Habitat.—Indigenous in South Europe and Asia Minor. The indigenous species met with in India (M. caulescens, *Clarke, Fl. Br. Ind. IV., 242*) occurs in Alpine Sikkim at an altitude of 12,000 to 13,000 feet. It is not known whether the roots of that species possess the medicinal properties assigned by older writers to the Mandrake.

MEDICINE. Root. 129

Medicine.—This plant has been mentioned by Birdwood among his drugs, but without giving any information about its medicinal virtues. The *Pharmacographia* says that the ROOT, as also that of M. officinarum, and of M. vernalis, are very nearly allied, in appearance and structure, to the roots of Atropa Belladonna, *L.* (see Vol. I, 351—353). O'Shaughnessy (*Beng. Disp., 466*) says that the root was celebrated in the magic rites and the toxicology of the ancients and is known now in the bazárs of Central Asia and Northern India. Its properties are said to be identical with those of Belladonna although weaker. Dr. Dymock informs the writer that it is worn as a charm in India. Irvine mentions that the drug is used in Patna as a narcotic in doses of $\frac{1}{8}$ to $\frac{1}{3}$ grain.

130

MANGANESE, *Ball, Geology of Ind., III., 326.*

The ores of Manganese are numerous and somewhat widely disseminated, though they rarely occur in any quantity in one place. Ball states that the commonest ores in India are Manganite, or the gray oxide; Wad, or the earthly protoxide; Pyrolusite, or the black peroxide; Psilomelane, a combination of the oxide with baryta; Hausmanite or peroxide occurring with other ores of the metal; and Braunite, or binoxide in combination with iron peroxide, silica and magnesia.

131

Manganese.

Syn.—BRAUNSTEIN, GLASSEISE, *Germ.*; SAVON DU VERRE, *Fr.*; BRUINSTEIN.

Vern.—Peroxide=*kolsa-ka-pathar, ingani, missi siyá*, HIND.; *Nijni, injani, ingani, jugni*, PB.; *Iddali kalu*, TEL.

References.—*Baden Powell, Pb. Pr., 100; Mason's Burma, 570, 587. 735; Balfour, Cyclop., II., 845; Ure. Dict Indus. Arts and Manu., III., 35; Madras Manual, of Admn., II., 36; Manual, Coimbatore District, 23; Settlement Reports Nagpore District. Sup. 276; Tropical Agril., Feb. 1889, p. 509; Forbes Watson's Ind. Surv., I., 406.*

OCCURRENCE. 132

Occurrence.—The following short account of the presence of the ores of manganese in India has been principally extracted from Ball's *Economic Geology* (*l. c.*), to which the reader is referred for fuller information:—

MANGANESE ores are chiefly found in the older crystalline or metamorphic rocks, but they occasionally occur in younger sedimentary and unaltered formatios. In India, indeed, a not unfrequent source is laterite, though in such a rock, as might be expected, the deposits are not constant over large areas. "It is possible," Ball writes, "that manganese is much more abundant in this association than is generally thought, since on the weathered surface it resembles ordinary laterite and might easily escape detection." Ores of manganese occur in MADRAS, in the Nilghiris, Mysore, Kadapah, Karnul, Bellary, Vizagapatam, and Hyderabad. In BENGAL, manganiferous limonite is found in some abundance in the neighbourhood of Chaibassa in Singbhum. In the CENTRAL PROVINCES a deposit of manganese ore is met with in the neighbourhoodof Gosalpur in the Jabalpur district, and in the metamorphic rocks north of Nagpur a rich black oxide is said to be abundant; an impure ore, probably of little value if saleable at all, has also been found in the red clays of the Kamthi series around Malagarh in the Berar, Wun district, and an impure psilomelane in the South Rewah coalfield. In RAJPUTANA a mixture of limonite, magnetite, and oxide of man-

Madras. 133

Bengal. 134

Central Provinces. 135

Rajputana. 136

ganese is found in the iron mines of Bhangarh in Alwar State, and small veins of oxide of manganese occur in fault rock near Dabunda in Bundi State. Deposits are said to have been found near Wodoorti, a locality in the Dharwar district of BOMBAY, but no recent account of the ore is available. In LOWER BURMA, the occurrence of manganese ores has been described at three localities in the vicinity of the Great Tenasserim river; one on the bank of the Thugoo stream, one on the Therabuen and the third at an intermediate spot where the Great Tenasserim intersects an outcrop of the ore. No opinion could be formed as to the extent of the deposit owing to the scarcity of stream sections, and the thickness of the vegetation, but it was thought to be not improbable that a bed of ore, several square miles in extent, existed, which united the three localities. Even without this being necessarily the case, it was said that sufficient to pay working could be obtained at these points. The ores consisted of black and grey oxides and wad. **Mason** states that he has seen manganiferous iron from one of the islands south of the Mergui. Pyrolusite has been obtained from UPPER BURMA, but nothing is known as to the mode of its occurrence.

OCCURRENCE.

Bombay. 137

Lower Burma. 138

Upper Burma. 139

ANALYSES OF INDIAN ORES.—Specimens of ore from Vizagapatam and Bimlipatam, were analysed by **Dr. A. J. Scott** in Edinburgh, who found them to contain 73·7 and 76 1 per cent. of red oxide of manganese respectively. The former, which from the analysis is considered by **Dr. Scott** to approximate most nearly in character to a variety called "marcellin" from **St. Marcellin** in Piedmont, is said to occur in large irregular masses of several tons' weight, probably included in laterite. Manganese oxide is reported to be obtainable in Bimlipatam for 2 annas a maund (*Vizagapatam Dist Man., 155*). Samples from Golaspur in the Jabalpur district were analysed by **Mr. Mallet** and were found to contain 75·86 per cent. of manganese calculated as the protosesquioxide and 9 96 of oxygen, giving 15·25 per cent. of available oxygen—an amount considerably above the average. This valuable ore was found to occur somewhat obscurely in laterite, but did not form either a regular lode or vein, nor was there any apparent connection between it and the underlying transition rocks. **Mr. Medlicott**, who examined the deposit, however, saw no reason for doubting, in spite of the irregular mode of occurrence, that a large supply of the ore might be obtainable.

CHEMICAL COMPOSITION.

An analysis of a sample of the ore from Ramtek in Nagpur was made by **Mr. Mallet**, who found that it contained 78·64 to 79·39 per cent. of the sesquioxide, giving 9·71 per cent of oxygen, a somewhat lower proportion than the ordinary commercial ores. The deposit, however, is near the surface, would be easily worked, and has been described as being ten feet thick and extending in a north-west to south-east direction for a quarter of a mile.

Medicine—Several of the compounds of this metal are, owing to their oxidising properties, of considerable value as disinfectants. At one time a mixture of sulphuric acid with the black OXIDE was used for purposes of fumigation, but is little employed now-a-days. *Condy's-fluid* consists of an impure PERMANGANATE of potash, which salt is a valuable disinfectant, and mild astringent.

MEDICINE.

Oxide. 140

Permanganate. 141

Industrial Uses—The uses to which the ores of manganese are put in the arts are somewhat varied. The peroxide is extensively employed in glass-making, to destroy the green colour of glass, which it does by converting the protoxide of iron into the peroxide; when added to excess it gives the glass a red or violet colour. The same oxide is used in porcelain painting for the fine brown colour which it yields. It is also employed for glazing pottery, and in the preparation of enamels. Its most valuable property, however, is the ease with which it gives off oxygen off the application of

INDUSTRIAL USES.

Glass-making. 142

Porcelain painting. 143

heat, a property which is largely taken advantage of in the arts. It is also used in the manufacture of chlorine and calcium chloride.

Of late years the ores of manganese have been extensively utilized in the manufacture of iron and of steel, by the Bessemer process, the latter especially. Manganese in the metallic state is said to deprive iron of its magnetism. Lately a process of application of this principle has been invented in England, by means of which the metal in the proportion of 27 per cent. is mixed with the steel used for ship-building; and it is contended that this mixture deprives the steel of its magnetic influence on the ship's compasses.

144 **MANGIFERA**, *Linn.; Gen. Pl., I., 420.*

A genus of trees which belongs to the Natural Order ANACARDIACEÆ and comprises some 30 species, which are found in tropical Asia, chiefly in the Malay Peninsula.

145 **Mangifera fœtida**, *Lour.; Fl. Br. Ind., II., 18;* ANACARDIACEÆ.

Syn.—M. HORSFIELDII and M. FŒTIDA, *Miq.*

Vern.—*La-móte*, BURM.; *Bachang*, MALAY.

References.—*Kurz, For. Fl. Burm., I., 305; Miq., Fl. Ind. Bat., I., Pt. 2, 632; Mason, Burma and Its People, 448, 774.*

Habitat.—A large tree, native of Malacca, Penang, and Singapore (cultivated in Southern Tenasserim) and distributed throughout the Malay Peninsula.

FOOD. Fruit. 146 Food.—Produces pink or dark red flowers, and a coarse-flavoured FRUIT which is eaten by the natives, and for which the tree is cultivated. Mason says: "This is a large Mango cultivated at Mergui, and is quite a favourite with the Natives. It has an odour resembling the dorian, and like that has been introduced from the Straits." Rumphius states that the fruit when eaten excites "cold exanthemata and fevers," and that it ought never be used except when very mature.

147 **M. indica**, *Linn.; Fl. Br. Ind., II., 13.*

THE MANGO TREE.

Syn.—M. DOMESTICA, *Gærtn.*

Vern.—*Am, ámb, amchur* (unripe fruit), *am-ki-gúthli* (seeds), HIND.; *Am, ambra*, BENG.; *Uli*, KOL.; *Ul*, SANTAL; *Jegachu, bocho*, GARO; *Ghariám, ám*, ASSAM; *Am*, URIYA; *Tsarat-pang*, MAGH.; *Ambe*, KURKU; *Ama*, BAIGAS; *Marka*, GOND; *Amb, ám, ánv.* N.-W. P.; *Am, amb, mawashi*, PB.; *Amb, amú*, SIND; *Amba, Am, Ambecha jhar*, DEC.; *Ambo, amba, am, amb*, BOMB.; *Amba*, MAR.; *Ambo*, GUZ.; *Am, ámb, ánv*, BUNDELKHAND; *Maá, mangas, mam-marum*, TAM.; *Elamávi, mámadi, mámid, mámidi, makandamu, guggu-mámidi, tiyya mámidi, racha mamidi, mávi, mamadichitá, tiya mamidi*, TEL.; *Mavina, mávu, amba*, KAN.; *Mava, mampalam, mánna.* MALAY.; *Thayet*, BURM.; *Makandamu, etamba* (wild), *amba* (cultivated), SING.; *Amra, chutu* (the juicy), *madha-dút* (messenger of spring), SANS.; *Amba, naghyak*, PERS.

References.—*Roxb., Fl. Ind., Ed. C.B.C., 215; Brandis, For. Fl., 125; Kurz, For. Fl. Burm., 304; Beddome, Fl. Sylv., t., 162; Gamble, Man. Timb., 107; Dalz. & Gibs., Bomb. Fl., 51; Stewart, Pb. Pl., 45; DC. Origin Cult. Pl., 200; Rheede, Hort. Mal., IV., t., 1, 2; Elliot, Fl., Andhr., 50, 64, 110, 113, 162, 183; Mason, Burma and Its People, 447, 774; U. C. Dutt, Mat. Med Hind., 140; Dymock, Mat. Med. W. Ind., 2nd ed., 196; Pharmacographia Indica, I., 381; S. Arjun, Bomb. Drugs, 32; Murray, Pl. and Drugs, Sind, 87; Year Book Pharm., 1880, 506; Irvine, Mat. Med. Patna, 120; Butler, Med. Top. Oudh and Sultanpore, 4; Macleod, Med. Top. Bishnath, 16; Buchanan, Statistics of Dinagepore, p. 159; Baden Powell, Pb. Pr., 338, 397; Atkinson, Him. Dist, 741, 741; Ec. Prod., N.-W. Provs., Pt. V., 57; Lisboa, U. Pl. Bomb., 53, 250, 257, 259, 279, 284, 289, 291; Birdwood, Bomb. Pr., 18, 146, 219, 261; Royle, Ill. Him. Bot., 53, 257; Atkinson, Gums and Gum-resins, I., 7; McCann, Dyes and Tans, Beng., 85, 139, 144, 160, 165, 168; Buck,*

The Mango Tree (*G. Watt.*) MANGIFERA indica.

Dyes and Tans, N.-W. P., 83; Liotard, Dyes, 33, 112, App. VIII.; Rep. Hort. Gar., Lucknow, March 1884, 2; 1885, 4; Rep. Bot. Gar. Ganesh Khind, Poona, 1882, 4; 1885, 4; 1885, 3; Watson, Rep., 4, 20, 33, 46, 50; Wardle, Rep. Dyes and Tans, Ind., 41, 43; Ayeen Akberi (Gladwin's), Trans., I., 84; II., 3, 41, 43; Blochmann's, 67; Wallace, India in 1887, 243; Smith, Dic., 263; Kew Off. Guide to the Mus. of Ec. Bot., 36; Kew Off. Guide to Bot. Gardens and Arboretum, 44, 71; Kew Bulletin, 1889, 23; Darrah, Note on Cotton, 31; Report, Forest Admn., Ch.-Nagpur, 1885, 6, 29; Linchoten, East Indies (1598), Ed. 1885, II., 23 to 26; Agri.-Hort. Soc., Ind:—Trans., I., 21; II., 13-16 (App.), 298, 300, 307; III., 58, 61, 65, 67, 68; IV., 104, 149, 179; VI. (Pro.), 60; VII., 104; Pro., 45, 186; VIII., 222; Journals, I., 262-273; II., Selc., 373; III., Pro., 182; IV., 54, 215; Selec., 89, 141; Pro., xci.; VI., 44; Sel., 107; Pro., 107, 108; VII., 71; Sel., 55; Pro., 31; VIII., Sel., 136, 138, 165, 178; IX., Sel., 56; X., 1, Pro., 40, 105; XI., Pro., 48; XIII., Sel., 59, 60, 61, 63; New series:—I., Sel., 59, Pro., 37; IV., Pro., 13, 14; V., 74; VI., 118-123, 141, 142 Pro., 2; VII., 325-327, Pro., (1883), 124, 136, 137, 148; VIII., 260-277, 292-305, Pro., 42, 43; Gazetteers:—Bombay, II., 39, 355; IV., 23, 24; V., 23, 24, 285, 360; VI., 12; VII., 38, 39, 40, 41; VIII., 94, 95; XI., 98; XIII., 23, 294; XV., 21, 72; XVIII., 41; N.-W. Provs.:—I., 80; III., 238; IV., lxx.; X., 308, 711; Oudh, II., 313; Mysore and Coorg, I., 53, 59; Settlement Reports:—Panjáb, Gurát Dist., 134; Karnal Dist., 16; Hoshiárpur Dist., 12; Sialkot Dist., 11; Simla Dist., xliv., App. II. H.; Kohát Dist., 30; Rohták Dist., 78; Delhi Dist., 27; Hazára Dist., 94; N.-W. Provs., Shajehánpur Dist., IX.; Allahabad Dist., 38; Central Provs., Upper Godávery Dist., 38; Mundla Dist., 88; Chindwára Dist., III.; Nimar Dist., 201; Port Blair, 1870-71, 33; Hunter, Orissa, II., 5; App. I., 158; App. IV., 179; App. VI.; Aplin. Rep. Shan States, 1887-88; Manuals:—Bombay, Rev. Accts., p. 102; Madras, Trichinopoly Dist., 78; Cuddapah Dist., 56, 263; Indian Forester, I., 363; III., 201, 237; IV., 230; VI., 240, 298, 321, 338; VIII., 402; IX., 211; X., 31, 470, 543; XI., 18; XII., 73, 188; XXII., App., 27; XIII., 120; Indian Agriculturist, Augt. 14th, 1886; 15th June, and 10th Augt. 1889.

Habitat.—A large, glabrous tree, found on the Tropical Himálaya, at altitudes of 1,000 to 3,000 feet, from Kumáon to the Bhután Hills, the various Asia Mountains, Burma, Oudh, Lower Hills of Behar, and in the forests of Western Peninsula from Khandesh southwards. Cultivated as far west as Muscat, in all Eastern Asia, and general in the tropics. DeCandolle writes: "It is impossible to doubt that it is a native of the south of Asia or of the Malay Archipelago, when we see the multitude of varieties cultivated in these countries, and the number of ancient common names."

HISTORY. 148

History.—From its indigenous home in India, which, according to De Candolle, was the region at the base of the Himálaya, especially towards the east, and in Arracan, Pegu, and the Andaman Islands, the cultivation of the fruit must have spread at an early age over the Indian Peninsula. According to Rumphius, it has been introduced into certain islands of the Asiatic Archipelago within the memory of "living men," while in others it has existed from a remote date.

There is no doubt that it has been known and cultivated all over the peninsula of India from a very remote epoch. It is closely connected with Sanskrit mythology and is mentioned in many of the old tales and folk lore of the Hindus. Linschoten, in his *Voyage to the East Indies*, mentions several varieties of mango, and his description indicates a very wide spread cultivation at that date. Abul Fazl, in the *Aín-i-Akbari* written about the same time (300 years ago), describes a large number of cultivated races and states that "Mangoes are to be found everywhere in India, especially in Bengal, Gujrát, Málwa, Khándesh, and the Deccan," localities all famous for the fruit at the present day. Talking of Behar he notices an interesting race, produced by cultivation (which also exists at the present day), "not so high as the ordinary stature of a man, and producing very delicious fruit."

CULTIVATIONS.

Cultivation.—The editor is indebted for the following account of the chief races of cultivated Mango, and of the methods pursued in growing them, to Mr. Maries of Darbhangah, an expert on the subject: –

Origin. 149

Origin.—"The cultivated mangoes of India have arrived at a great stage of perfection and consist of very numerous races, although these are unknown to most people, except as Bombays, Lungrahs (Lengras), and Maldas.

The many dozens of sorts sold in the bazárs under these three names have given the idea that there are only three kinds of mangoes fit to eat. These three names really represent three distinct strains of cultivated fruits. It is interesting to note the changes that have taken place in these fruits The form or shape has continued almost the same as that of the wild varieties, but the flavour has developed from "tow and turpentine" to something too exquisite to express in words, each good variety having a flavour of its own. On examining, for example, the outline of the Kangra varieties, one notices the true shape of the Bombay "*afooz*," one of the finest mangoes; also in the Tirhoot mangoes, one sees a great similarity to a sort called "Kishunbogh." I have seen two types of wild mangoes; one very variable from Kangra, and one from Sikkim, but these may be viewed as manifesting the two great shapes of cultivated mangoes.

Selection. 150

Improvement by selection.—The latter wild sort is evidently the progenitor of the Malda cultivated varieties; the Kangra form might naturally be viewed as the ancestor of the Western Indian sorts, but these two wild varieties almost unaltered have been met with under cultivation in Tirhoot, and they produce all the different families of cultivated mangoes, as the result of accidental or artificial selection. Till recently mangoes were always planted from seedlings, and even now this is frequently the case. When the trees fruited, the good sweet ones were allowed to grow, while the sour and worthless were cut down and used as firewood. In this way, selection took place and is going on at the present time in Tirhoot and Northern Bengal, and I suppose in other districts. The intercrossing of the flowers of the primary races has produced innumerable subvarieties of fruit of all sorts, sizes, and quality, only the best of which have been grown and propagated to any extent.

Propagation. 151

Propagation.—Mangoes are propagated by inarching, that is grafting by approach. They can be grafted in other ways, but inarching is the simplest. They can be also grown from seeds. In fact if only the finest and best sorts be selected, the chances are that 50 per cent. will be as good as the fruit sown, a few better and the rest worse. I should advise planting seedling mangoes, where grafts are difficult to obtain, taking for the seed only such sorts as *Afooz Puary*, *Kishenbogh*, *Durbhungah*, *Bombay*, *Fuzlee* and good forms; and then only from well-formed, quite ripe fruits. The season of ripening too might be prolonged if such kinds as *Rhori Budaya*, *Mohur Thakoor*, and other *Budaya* sorts were used for seed. This was done on rather a large scale in Durbhungah A good mango seed should never be thrown away; always plant it if possible.

Soil. 152

Soil and Cultivation.—Mango trees grow everywhere in the plains of India The home of the tree in the Himálaya is from 1,000 to 2,000 feet. It seems to grow as well in a swamp as on a bund, but the best fruits and finest trees in the plains are always produced on trees grown on raised ground. The soil does not seem to interfere much with the tree. In Bengal, it grows equally well in a rich deep river deposit, in clayey, or in sandy soil In Gwálior we have fine trees in *kankar*, with enormous crops of fruit. The best place to plant mangoes is on a raised, well drained piece of land with a good depth of soil. When the trees are young, the land between them should be well cultivated every year,

CULTIVATION.

and round the young trees the ground should be dug up and stirred frequently. When the trees are about 10 feet high, the ground for a space of 10 or 12 feet all round should be dug up in January or February and manure well mixed with the soil. In Bengal, where irrigation is not generally necessary, this manuring would be best done after the fruit has been gathered. In Central India I do it in February. Where mango trees are irrigated, as they are in Gwalior, Allahabad, and other similar localities, no water should be given after the rains to fruiting trees; allow the plants to dry up and get well ripened. If this be done, a crop of fruit every year will be the result. Our trees are about 20 feet high. We do not irrigate after the rains. We dig up and manure the ground around the trees in February, and when the fruit is set we water from a well, every 8 or 10 days, till it becomes ripe, and the rains begin. This treatment has been carried on for two years; we had a good crop last year; this season we have an enormous one. If irrigation is carried on all the year round, the flowering season is brought on prematurely, the flowers are deformed, and become large masses of leafy flowers that hang on the trees for months and produce no fruit.

Planting 153

Planting.—The best time to plant mangoes is in the rains—July. The native method of growing plantain trees round them is very good, but instead of planting one or two for "luck," I grow four or five for shade and protection, taking them out when the mango tree is strong enough to stand the climate. In laying out a plantation the trees should be put at least 30 feet apart. The holes for planting should be prepared six months beforehand, dug up well, and a little very old manure mixed with the soil.

Races. 154

Cultivated Races.—Of cultivated sorts of mangoes I have collected upwards of 500, and from these have selected 100 good ones. Mangoes may be obtained to fruit in succession, from May till November. Thus the Bombay *Afooz* fruits in May. The *Kuabogh* of Tirhoot also does so, while the *Budavas* and *Kailkees* fruit in September to November in Tirhoot and Malda. In 1885, in Durbhungah, I had mangoes every day for five months. In that year a list of fruits was selected and grafts were made of all. These were grown in model plantations. One plantation of about 125 trees was selected from stock derived from the Madras Horticultural Society, Calcutta Nursery men, Chanchal estate, Malda, and Bombay: the sorts planted were as follows:—

Madras. 155

Madras.—Peter mangoe, Goa, Mulgova, Komaine, Ameercola, Dilpusund, Wallajah pusund, Office pusund.

Malda. 156

Malda.—Fuzlee bewa, Bura jalli bund, Chota jalli bund, Latcuspu, Mohunbogh, Lumba budaya, Dilshoj.

Durbhungah. 157

Durbhungah.—Kuabogh, Durbhungah-Bombay, Gopalbogh, Kakoria (cucumber-mango), Gobinpoor-ka-Sinduria, Khupurwa (camphor). The melon mango, peculiar to this district, is known as Naroi-ka-kerbuza, Mohidinugger kerbuza, Dhoola walla kerbuza also Nursinghbogh, Maharaj pusund, Derruna, Kishenbogh, Gowrays, Bhoopolie, Kurrelna, after the fruit Kurela and many others.

Bombay. 158

Bombay.—Pieary, Afooz, Salem favourite.—In laying out a plantation of mangoes the trees should be so arranged that the season of ripening comes in order: the early mangoes planted to the east, medium mangoes in the middle, late magoes, west. In the large Durbhungah plantation of about 65 acres, there are three sections arranged as above.

The following descriptive list of good sorts of mangoes may be found useful; it is referred to five sections:—

Afooz. 159

I. *Afooz.*—This is the celebrated Bombay mango, a lovely orange colour, with reddish flesh. It is really not a Bombay fruit at all, but probably

CULTIVATION. Races.

came originally from Salem. Absurd prices are often paid for this fruit, as much as R60 per 100 being given by dealers. Like most mangoes this should never be eaten fresh, but should be gathered ripe from the tree and laid upon a shelf for a few days to fully mature. Weight, 8 to 12 ozs.

Kunbogh. 160 — *Kunbogh.*—A Tirhoot mango, of which the quality is as good as the finest Afooz. It is a small green fruit and ripens early. The name signifies 'crow's food.' It weighs about 4 ozs. Season May.

Durbhungah-Bombay. 161 — *Durbhungah-Bombay.*—This is the Bombay of the up-country gardens and about the best known mango. A very old plantation exists at Norgona, Durbhungah, and another called the Lakh Bagh, near Somaspur, had once upon a time a lakh of trees, said to be of this kind. Season May, June.

Safada. 162 — *Safada.*—A whitish variety of the above, better in quality I think. Season May, June.

Gopalbogh. 163 — *Gopalbogh.*—A Malda sort. This is the celebrated Malda kind said to be equal to the Afooz. It hangs till late in June, and is a superior fruit. It is very like Durbhungah-Bombay but smaller. Weight, 6 ozs.

Kakoria 164 — *Kakoria* (*cucumber-plantain*).—Very like a cucumber, often 7 to 10 inches long by 2½ inches wide; a most luscious, refreshing fruit; weighs from 10 ozs. to 1lb. It is a plentiful variety in Tirhoot, but is seldom gathered in good condition, and is often sour. When gathered ripe from the tree, and kept for a couple of days, it is a perfect fruit.

Kurrelna. 165 — *Kurrelna.*—Named after Kurela (Momordica). This is a variety of the cucumber mango, smaller and covered over with greenish warts like a Kurela fruit. It weighs 8 to 12 ozs. Season July.

Banka. 166 — *Bánka* that is, 'twisted.' This is a large green fruit totally unlike any mango I know. It is twisted, weighs 1lb and has a strong flavour; it is a very rare sort. Season July.

Ameercola. 167 — *Ameercola.*—Madras fruit; weighs 10 ozs., has a rough skin like an orange, a very peculiar shape, and very distinct. Season July.

Dilpusund. 168 — *Dilpusund.*—Several fruits bear this name, and the one I received from Madras is like the Durbhungah *chupki* (flat) or *chupra*. It is a desirable fruit and very good looking. Season July.

Durma. 169 — *Durma or Derrma*, from Lawanie Tirhoot. The true sort is one of the finest of mangoes. It varies in size from 8 ozs to 1lb, and is a round yellowish fruit of most exquisite vanilla-like flavour; the flesh is rather hard, but melts in the mouth. There is another variety of this, a red fruit, which at first sight might be mistaken for a Blenhiem orange apple. Season June and July.

Kishenbogh. 170 — *Kishenbogh Durbhungah*—A celebrated fruit, which, since the railway has been opened, is sold with Gowraya Malda by thousands in the Calcutta markets. It is a round fat mango, of first rate quality. Season July.

Kishenbogh.—This fruit often hangs on the tree till the seed germinates inside. I have had several examples of this, in which the young plant has grown completely out of the fruit. The flesh of the mango in these cases had become quite hard, and tasted like a carrot.

Lerrua. 171 — *Lerrua or Lerrna*—(from *Ladu*, a sweetmeat). This is the most beautiful of all mangoes, the mixture of orange red and green, in stripes and blotches, resembles the colouring of a ripe apple. Season July.

Shah pusund. 172 — *Shah pusund*—(generally called Malda). A fine large, irregular shaped fruit of fair quality, largely grown as it is hardy and a good cropper; some of the fruits weigh 2lb. Season June and July.

Gowraya. 173 — *Gowraya Malda.*—A Tirhoot mango, also called "*Safada Malda*" and "*Tikari.*" A good specimen of this is one of the finest mangoes in India. It cannot be mistaken, as it is the type of the large class of raised stoned mangoes. It has an aroma and flavour distinct from those of any fruit I know. The skin is as thin as writing paper, and the stone so tender

CULTIVATION. Races.

that when cut, the knife often goes through it. There are many forms of this race; the best I have named after Mr. Buckley, as Buckley's Gowraya Malda

Kumukht. 174

Kumukht.—The skin of this is rough and leathery; it is a very irregular shaped round fruit, often with the pistil scar or "Nak" developed in a most curious way; a fine flavoured and rare fruit. Season July. Weighs 8 ozs.

Bhupali. 175

Buhpali.—A small ovoid mango, often perfectly crimson, vermillion, and yellow in colour, perhaps the best of all mangoes. I have obtained it from several places in Tirhoot, but always of the same fine quality. Season July. Weighs 6 ozs.

Inerna. 176

Inerna—(meaning spontaneous). This is the largest mango, some specimens attaining a weight of 4lb. It is of good flavour, but is a rare fruit. Season July and August. It came up from seed in a native gentleman's garden in Durbhungah and only one tree was supposed to exist.

Nursinghbogh 177

Nursinghbogh—A blue mango weighing 1½lb. It can be readily distinguished by its leaf which frequently is as much as 18 inches long. Season July and August. A good fruit.

Maharaj Pusund. 178

Maharaj pusund—A Tirhoot fruit of fine quality though common and well known. Weight 6 ozs. Season July.

Kerbuza. 179

II. *Kerbuza mangoes.*—We come now to a distinct class of mangoes called in Tirhoot kerbuzas or melons, from the musk scent they possess. There are three good kinds, all of which are of fine quality and ripen late in July, *Naroika kerbuza, Mohedenugger kerbuza, and Dhoola walla kerbuza,* all three should be in every collection.

Budayas. 180

III. *Budayas.*—The above mangoes are generally all over by the end of July, but sometimes hang till August. The class of mangoes called Budayas and Maldas (true) have all peculiar shaped fruits, and seldom ripen before the middle of July, and with care and protection will keep till October. These fruits may be seen hanging on the tree in October protected by little Bamboo baskets from wasps, birds, &c. In 1885, I had some fruits gathered fresh from the tree in excellent condition on the 30th October.

Khari Budaya—Ripens first. Season July-August. Weighs 8 ozs.

Terha Kellua. 181

Terha Kellua—(The crooked plantain). Always a long, ugly fruit, with the stalk on one side, hence the name. Weighs 1 to 1½lb. It comes from Chanchal in Malda.

Fuzlee Bewa. 182

Fuzlee Bewa.—The large mango one sees in Calcutta, weighing 1 to 2lb, very common in the bazar there in August; these fruits sometimes fetch as much as 1 rupee each.

Jalli bund. 183

Jalli bund (seed in a net), because after the skin has been taken off, the flesh appears to be in a yellow thread net; this is from Malda, and is an excellent fruit. Season August and September. Weighs 1 to 1½lb.

Durbhungah Budaya—or *souria budaya*—a very first class mango, flattish and good looking; it has no fibre, a very thin skin, and a small thin stone; ripens August. Weighs 10 ozs. to 1lb.

Nukkna Lungra. 184

Nukkna Lungra.—So named because the pistil scar develops into a prominent nose-like projection. This is a Durbhungah mango and is a very good sort. Season, August and September.

Mohunbogh. 185

Mohunbogh—From Malda and Monghyr, a very large, round, irregular shaped fruit, 1½lb weight, of fair flavour.

Mohur Thakoor. 186

Mohur Thakoor.—One of the latest and best mangoes, very ugly, and very irregularly shaped. They hang on the tree till October; weight 1 to 1½lb

Tars. 187

Tars—The native name of the Borassus palm. This mango is just like the fruit of palm of the same name; it weighs 1 to 1½lb, is good eating and ripens in September.

MANGIFERA indica. — The Mango Tree.

CULTIVATION. Races.

Barramassia.

Luttea. 188

IV. *Barramassia* (meaning twelve months). There are several varieties of the perpetually fruiting mango, none very good. They are grown more as curiosities than anything else.

V. *Luttea*.—The creeping mango.

This is really not a creeping mango, but a decumbent variety, produced by grafting. There are several varieties of it. Mr. Chatterjee, the Calcutta Nurseryman, has one variety that grows along the ground and bears small roundish fruits. Another is trained on a *machan*, and bears large fine-shaped fruits. It is a true mango, and a cultivated sport. I have had samples of fruit of *Luttee am* from Tirhoot, and they prove to be "*Shah pusund*" and "*Dhosla walla kerbuza*." I am informed these two trees were originally staked and trained down to the ground, and bore fruit in this way. After a considerable space was thus covered, eventually the training ceased, and the trees at once grew up and formed straight stems."

[This form has probably given rise to the accounts of creeping and vine-like mangoes mentioned in the *Ain-i-Akbari*, by Wallace in his "India in 1887," and by other writers. *Conf.* with Willughbeia edulis under INDIA-RUBBER, Vol. IV., 363.—*Ed.*]

GUM. 180

Gum.—The bark yields a gum, which, according to Atkinson, is frequently sold in the bazars as gum arabic.

DYE & TAN. Bark. 190 Leaves. 191

Dye, Tan, and Mordant.—The BARK and LEAVES yield a yellow dye which is not much used. In Monghyr, the BARK is employed with that of Bassia latifolia, Punica granatum, and Bauhinia variegata for dyeing yellow, and in Lohardaga it is used in combination with the barks of several other trees in obtaining a permanent black. The Magistrate of Chittagong states that in his district "the juice of the bark obtained by simple beating and mixed with lime yields a fleeting green dye." The Forest Officer, Palanpur, Bombay, recently sent to the Editor a piece of cotton cloth dyed a bright rose-pink with mango bark, turmeric and lime—perhaps one of the best colours in the admirable collection of Palanpur dyes kindly furnished by that gentleman. Samples of the bark were sent by Government among other dye stuffs to Mr. Wardle for examination. It yielded, by his processes, a series of very beautiful though generally light and more or less yellow, shades of brown, slate, and drab, when used with cotton, silk, and wool. The pulp of the FRUIT, also experimented with by him, produced yellowish drab or grey shades, which were little affected by the different processes employed for silk or cotton.

Fruit. 192

The bark is employed for tanning in the Dacca district and Bankura; the leaves are similarly employed by the poorer classes in Oudh. The dry unripe fruit is largely used as a mordant specially in dyeing with safflower.

OIL. 193 Seed. 194

Oil.—Dr. Cooke states that the SEEDS contain a large percentage of oil, but no information apparently exists, either as to the method of preparing it or as to its uses.

MEDICINE. Fruit. 195

Medicine.—The FRUIT has long been considered a valuable medicine both by Hindu and Muhammadan physicians, and has formed the subject of many articles by writers on the Materia Medica of the East. Thus, in the *Bhavaprakasa*, a confection made of the juice of the ripe fruit, sugar, and aromatics is recommended as a restorative tonic. It is, however, unnecessary to enter into a detailed account of the opinions of older writers on what is after all an unimportant drug. The following extract from the recently published *Pharmacographia Indica*, together with the somewhat numerous list of Special Opinions below, may, therefore, suffice to indicate the principal medicinal properties supposed to be possessed by the fruit:—

"Shortly, we may say that the ripe fruit is considered to be invigorating and refreshing, fattening, and slightly laxative and diuretic; but the rind

and fibre, as well as the unripe fruit, to be astringent and acid. The latter when pickled is much used on account of its stomachic and appetising qualities. Unripe mangoes peeled and cut from the stone and dried in the sun form the well-known *Amchúr* or *Ambosi* (*Amrapesi*, SANS.), so largely used in India as an article of diet; as its acidity is chiefly due to the presence of citric acid, it is a valuable antiscorbutic; it is also called *Am-ki-chhutta* and *Am-khushk*. The BLOSSOM, KERNEL, and BARK are considered to be cold, dry, and astringent, and are used in diarrhœa, &c., &c. The smoke of the burning LEAVES is supposed to have a curative effect in some affections of the throat. According to the author of the *Makhzan*, the Hindus make a confection of the baked pulp of the unripe fruit mixed with sugar, which in time of plague or cholera they take internally and rub all over the body; it is also stated in the same work that the midribs of the leaves calcined are used to remove warts on the eyelids. Mangoes appear to have been known to the Arabs from an early date as a pickle; they were doubtless carried to Arabian ports by Indian mariners. Ibn Batuta, who visited India A.D. 1332, notices their use for this purpose. The powdered seed has been recommended by Dr. Kirkpatrick as an anthelmintic (for lumbrici) in doses of 20 to 30 grains, and also as an astringent in bleeding piles and menorrhagia. (*Phar. of India*. 59)." It may be here noted that this property of the seed is described by Paludanus in his Notes on Linschotan's Travels. He writes: "Being raw it is bitter of taste and is therefore good against worms, and looseness of the belly; against worms when it is eaten raw, and against looseness of the belly when it is roasted." "From the fruit just before ripening, a gummy and resinous substance exudes, which has the odour and consistence of turpentine, and from the bark a GUM is obtained which is partly soluble in cold water." Ainslie says that the gum-resin mixed with lime-juice or oil is used in scabies and cutaneous affections. The juice of the ripe fruit dried in the sun so as to form thin cakes (*Amras* or *Amaut*, HIND.; *Ampapoli*, MAR.; *Amravarta*, SANS.) is used as a relish and antiscorbutic. Mango bark and fruit have been lately introduced by Dr. Linguist to the notice of European physicians (*Practitioner*, *1882*, *220*); he recommends it for its extraordinary action in cases of hæmorrhage from the uterus, lungs, or intestines. The fluid extract of the bark or rind may be given in the following manner:—Ext. Fl. Mangif Ind., 10 grains; water, 120 grains. Dose—One teaspoonful every hour or two, or the juice of the fresh bark may be administered with white of egg or mucilage and a little opium."

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Flower. 196
Kernel. 197
Bark. 198
Leaves. 199

Gum. 200

In addition, it may be stated that in the Panjáb and Sind a gruel made of the kernels is administered in cases of obstinate diarrhœa and bleeding piles, and that the seeds are also considered useful in asthma.

CHEMICAL COMPOSITION.—The following is extracted from the *Pharmacographia Indica*:—

Chemistry. 201

"Professor Lyon (1882) examined the dried unripe peeled fruit, and found it to contain water 20·98, watery extract 61·40, cellulose 4·77, insoluble ash 1·43, soluble ash 1·91., alkalinity of soluble ash as potash ·41, tartaric acid, with a trace of citric acid 7·04, remaining free acid as malic acid 12·66, total free acid per 100 parts air dry substance 24·93.

The orange colouring matter of the ripe mango is a chlorophyll product, readily soluble in ether, bisulphide of carbon and benzol, but less readily soluble in alcohol. It yields with these solvents deep orange-coloured solutions which are bleached by solution of chlorinated soda, and turned green by hydrochloric or sulphuric acids, the orange colour being again restored by an alkali.

MANGIFERA indica. — The Mango as a Medicine.

MEDICINE. The bark and seeds contain a tannin. Fifty grams of the powdered seed exhausted with alcohol, 90 per cent., filtered, the alcohol evaporated off on the water bath, and the residue dried over sulphuric acid, left an extract weighing 3·16 grams. Of this extract ·3 gram was of a resinous nature, and insoluble in water. The portion soluble in water, equivalent to 5·72 per cent. of the seed, gave the usual reactions of a tannin. The aqueous solution of the tannin was precipitated with gelatine, filtered, and the filtrate shaken two or three times with ether. No appreciable residue was obtained by the evaporation of this ethereal extract showing the absence of gallic acid. (*F. G. Prebble*)."

SPECIAL OPINIONS.—§ "The smoke of the burning leaves is supposed to have a preventive effect in hiccough" (*Civil Surgeon J. Anderson, M.B., Bijnor, North-Western Provinces*). "The unripe fruit roasted, dissolved in water and made into *sherbet* with sugar is freely taken by the natives to prevent sunstroke, the pulp is also rubbed over the body for the same purpose" (*Assistant Surgeon N. R. Banerjee, Etawah*). "The kernel of the seed is used for dysentery" (*Surgeon-Major P. N. Mookerjee, 32nd Regiment, Madras Native Infantry, Cuttack, Orissa*). "The powder of the dried kernel is useful in diarrhœa and chronic dysentery, as an astringent" (*Assistant Surgeon Nehal Sing, Saharanpur*). "Unripe mangoes toasted and made into *sherbet* form a reputed remedy for heat apoplexy" (*Assistant Surgeon T. N. Ghose, Meerut*). "I was lately told by a very intelligent patient that he had found the mango decidedly anthelmintic" (*Surgeon Major Farquhar, M.D., Ootacamund*). "*Amchur* is the very best antiscorbutic that I know. I have found it stamps out scurvy when lime juice and all other available remedies had been tried in vain" (*Brigade Surgeon C. Joynt, M D., Poona*). "The dried kernel of the ripe fruit is used as an astringent in diarrhœa" (*Civil Surgeon R. Gray, Lahore*). "The liquid extract is as efficacious as *bael* in dysentery" (*Civil Surgeon G. C. Ross, Delhi, Panjáb*). "Flour made from the kernel of ripe mango seeds when dried, is made into *chápatis*, and eaten by men of low caste, in the North Western Provinces" (*Surgeon A. C. Mukerji, Noakhally*). "The kernel is a constant and unfailing remedy for diarrhœa and dysentery amongst the hill tribes of the Sourah Mahlias. In my travels as Deputy Superintendent of Vaccine, I had frequent opportunities of noting the effects of the drug. When the Sourahs came down to the plains and remained for a week or more, they were very subject to diarrhœa or dysentery. They then eagerly sought for the seeds and used half a kernel in the morning and half in the evening. This treatment they continued for two or three days with marked effect and perfect cure resulted in five days at latest" (*Honorary Surgeon E. A. Morris, Tranquibar*). "I have never observed any laxative effects from eating the ripe fruit or heard of its being eaten with this object; if true it would not be safe to eat the fruit in large quantities when cholera is prevalent, as it often is in India during the mango season. The kernels of the seeds are sometimes roasted and eaten as food by the poorer classes in times of scarcity" (*Brigade Surgeon G. A. Watson, Allahabad*). "The dried flowers, either in the form of decoction or powder, are used as a useful astringent in looseness of the bowels, chronic dysentery, and gleet" (*Assistant Surgeon S. Arjun Rawat, L. M., Girgaum, Bombay*). "The gum of the mango tree is used for cracked feet with good effect" (*Surgeon-Major J. North, Bangalore*). "The green fruit is softened by roasting, mixed with water and used by the natives of Upper India in sunstroke and burning of the body. *Amchur* and pickles prepared from green fruit are issued to prisoners in jails as antiscorbutics. The kernels are dried and stored for medicinal use. In times of scarcity the flour of dried kernels is used by the poor as an article of

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diet" (*Assistant Surgeon S. C. Bhattercharji, Chanda, Central Provinces*). "The kernel (powdered) with resin and kurchi is given in dysentery. I have seen several cases cured by this. Dose: equal quantities of each ingredient mixed and about 15 grains given twice or thrice a day to adults" (*Assistant Surgeon N. N. Bhattacharjee, Tirhoot State Railway, Somastipore*). "The kernels powdered when thoroughly dry are used as food in the North-West, being made into *chapátis*," (*Narain Misser, Kothe Bazar Dispensary, Hoshangabad, Central Provinces*). "The unripe fruit cut and dried is a valuable antiscorbutic. It is now in use in Bengal jails" (*Surgeon R. L. Dutt, M.D., Pubna*). "The ripe fruit is laxative. The kernel of the seed is used as an astringent in diarrhœa. This is one of the ingredients of Pogson's Bael powder. The baked green fruit is made into a *sherbet*, and the pulp applied also externally in sunstrokes" (*Bolly Chand Sen, Teacher of Medicine*). "If the small white kernel of the mango stone be steeped in a little water and reduced to the consistence of paste, it may be applied to any part of the skin which *burns*, and it will soon have a cooling effect" (*Surgeon W. Wilson, Bogra*). The unripe fruit is used by the natives in the form of sherbet as a refrigerant and diaphoretic. The juice is used in fissures of the feet and between the toes or fingers" (*Civil Surgeon J. H. Thornton, B.A., M.B., Monghyr*). "The kernel of the stone has been frequently used in diarrhœa of children with success, in 1 to 3 grain doses alone or with dried bael" (*Assistant Surgeon N. L. Ghose, Bankipore*).

FOOD. Fruit. 202

Food.—The mango is a favourite FRUIT among both Natives and Europeans, and is very largely eaten throughout the country. In many parts of India, it serves as an important addition to the resources of a large section of the native population who own the trees. Fine, luscious fruits, weighing ½lb each, were, a few years ago, produced on an old tree in the Kew Gardens, London.

Besides being eaten as a ripe fruit, the mango is used as follows:—

"*When green*, the stone is extracted, the fruit cut into halves or slices, and (*a*) put into curries; (*b*) made into a pickle, with salt, mustard oil, chillies, and other ingredients; (*c*) made into preserves and jellies by being boiled and cooked in syrup; (*d*) boiled, strained, and with milk and sugar made into a custard known as mango-fool; (*e*) dried and made into the native '*ambchúr*,' used for adding acidity to certain curries; (*f*) when very young cut into small pieces, mixed with a little salt, and sliced chillies and milk added, it forms a 'tasty' salad.

"*When ripe* (*a*) it is made into curry which has a sweet acid, not unpleasant, taste; (*b*) it is cut into small pieces and made into salad with vinegar and chillies (the sour fruit is sometimes so used); (*c*) the juice is squeezed out, spread on plates and allowed to dry; this forms the thin cakes known as *amb-sath* (*Mr. L. Liotard*). The KERNELS are eaten in times of famine, and by the poorest classes in many parts of India they are boiled and eaten with greens. They are also ground into meal and mixed with various other ingredients to form the relish known as *ám-khatai*. When stuffed with coriander, turmeric, and other spices, and boiled in mustard oil, they are esteemed a great delicacy.

Kernels. 203

Preserves, chatnies, and pickles are made from the mango fruit and largely exported to England and elsewhere. Linschoten and Rumphius both describe a method of eating the fruit now almost unknown in the country, and probably introduced by the Portugese as suited to their tastes. The former traveller writes: "This is ye best and ye most profitable fruit in al India, for it yieldeth a great quantity for food and sustenance of the country people, as olives do in Spaine and Portingale. They are gathered when they are greene and conserved, and for the most part salted in pots, and

MANGIFERA indica. — The Mango Tree.

FOOD.

commonlie used to be eaten with rice, sodden in pure water, the huske being whole, and so eaten with salt mangas, which is the continuall food of their slaves and common people, or else salt dried fish instead of mangas." "These salted mangas are in cutting like the white Spanish olives, and almost of the same taste, but somewhat savorie, and not so bitter." "There are others that are salted and stuffed with small pieces of greene ginger, and garlike sodden; those they call Mangas Recheadas, or Machar." Rumphius states that salted mangoes were also much eaten in curries with fish.

There seems to be little truth in the charge frequently brought against the mango, that it is a fruitful cause of boils. The blue stain produced on the cutting knife results from the presence of gallic acid in the pulp, which likewise contains citric acid and gum.

TIMBER. 204

Structure of the Wood.—Grey, coarse-grained, soft, weight 41lb per cubic foot.

It is used for planking, door and window frames, in Calcutta for packing cases, and in Behar for indigo boxes; canoes and Masula boats are also made of it (*Gamble*). When employed for packing cases it should be previously well seasoned, otherwise the acid it contains is stated to corrode the lead lining. It is stated to be fairly durable, if not exposed to wet, but is liable to be worm eaten. Bareilly chairs are reported to be generally made of mango wood.

DOMESTIC & SACRED.

Domestic and Sacred.—The mango is held sacred by the Hindus and is inextricably connected with many of their mythological legends and folklore. The following extract from the *Pharmacographia* indicates some of these ideas:—

TREE. 205

"The mango, in Sanskrit *Amra*, *Chúta* and *Sahakara*, is said to be a transformation of Prajápati (lord of creatures), an epithet in the Veda originally applied to Savitri, Soma, Tvashtri, Hiranga-garbha, Indra, and Agni, but afterwards the name of a separate god presiding over procreation (*Manu*, xii., 121). In more recent hymns and Bráhmanas Prajápati is identified with the universe.

TWIGS. 206

FLOWERS. 207

"The tree provides one of the *pancha-pallava* or aggregate of five SPRIGS used in Hindu ceremonial, and its FLOWERS are used in Shiva worship on the Shivarátri. It is also a favourite of the Indian poets. The flower is invoked in the sixth act of Sakuntala as one of the five arrows of Kámadeva. In the travels of the Buddhist pilgrims Fah-hian and Sung-yun (translated by Beal), a mango grove (Amravana) is mentioned, which was presented by Amradárika to Buddha in order that he might use it as a place of repose. This Amradárika, a kind of Buddhic Magdalen, was the daughter of the mango tree. In the Indian story of Súrya Bai (*see Cox, Myth. of the Arian Nations*) the daughter of the sun is represented as persecuted by a sorceress, to escape from whom she became a golden Lotus. The king fell in love with the flower, which was then burnt by the sorceress. From its ashes grew a mango tree, and the king fell in love first with its flower, and then with its fruit; when ripe the fruit fell to the ground, and from it emerged the daughter of the sun (Súrya Bai), who was recognised by the prince as his lost wife."

Lisbon further informs us that "In *Smritisar Granth* the twigs of the tree are ordered to be used as tooth-brushes, and its LEAVES as platters in *panch pakshi* [illegible] day of *Maha Shivrátri* in the month of *Mágh*. The leaves are also employed in adorning *mandaps* and houses on occasions of various ceremonies." The twigs and leaves are largely used for cleaning the teeth, and the twigs as a substitute for *pan*.

LEAVES. 208

Cassava, Tapioca, Manioc. (*G. Watt.*) MANIHOT utilissima.

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Mangifera oppositifolia, *Roxb.*; see Bouea burmanica, *Griff.*; Vol. I.,

M. sylvatica, *Roxb.*; *Fl. Br. Ind.*, *II.*, *15*. 209

Syn.—M. INDICA, *Wall.*, *Cat. 8487*, *I.*

Vern.—*Kosham*, HIND. & BENG.; *Lakshmi am*, SYLHET; *Bun am*, ASSAM; *Chuchi am*, NEPAL; *Katúr*, LEPCHA; *Bagnal*, MICHI; *Hseng neng thayet*, *sinmirthayet*, BURM.; *Kosámra*, SANS.

References.—*Roxb*, *Fl. Ind.*, *Ed. C.B.C.*, *216*; *Voigt*, *Hort. Sub. Cal.*, *272*; *Kurz*, *For. Fl. Burm.*, *I.*, *304*; *Gamble*, *Man. Timb.*, *108*; *Mason*, *Burma and Its People*, *448*, *774*; *U. C. Dutt*, *Mat. Med. Hind.*, *305*; *Indian Forester*, *IX.*, *28*.

Habitat.—A large evergreen tree met with in tropical Nepál and the Sikkim Himálaya, in Sylhet and the Khásia Mountains. According to Kurz, it is found also in the Andaman Islands and rarely in the tropical forests of the Martaban hills.

Medicine.—The FRUIT is dried and kept for medicinal purposes (*Roxb.*). MEDICINE. Fruit. 210

Food.—The FRUIT is eaten by the natives, though by no means so palatable as even a bad domestic mango (*Roxb.*). The LEAVES are used in Assam to feed the silkworm Cricula trifenstrata. FOOD. Fruit. 211 Leaves. 212

Structure of the Wood.—Grey, moderately hard. Weight 34 to 41lb per cubic foot. It has been recommended and tried for tea chests, but when used unseasoned, has been found to corrode the lead foil, thereby spoiling the tea. TIMBER. 213

Mango, see preceding article on Mangifera.

Mango Fish or Polynemus indicus, see Fish, Vol III., 391.

Mango ginger, see Curcuma Amada, *Roxb.*; SCITAMINEÆ; Vol. II., 652.

Mangosteen, see Garcinia Mangostana, *Linn.*; GUTTIFERÆ; Vol., III.,

[470.

Mangosteen Oil, Brindonia-tallow, or Kokum-butter; see Gar-

[cinia indica, *Chois.*; GUTTIFERÆ; Vol., III., 466.

Mangrove Bark, a valuable tanning material. The following are the chief barks known commercially by this name—arranged alphabetically:— 214

Avicennia officinalis, *Linn.*; VOL. I., 360. (THE WHITE MANGROVE.)

Bruguiera gymnorhiza, *Lamk.*; VOL. I., 541.

B. parvifolia, *W. & A.*

Ceriops Candolleana, *Arnott*; VOL. II., 261. (THE BLACK MANGROVE.)

C. Roxburghiana, *Arnott*; VOL. II., 261.

Kandellia Rheedii, *W. & A.*; VOL. IV., 565.

Rhizophora mucronata, *Lamk.*; VOL. VI. (THE TRUE MANGROVE.)

MANIHOT, *Adans*; *Gen. Pl.*, *III.*, *306*.

Manihot Glaziovii, *Müll. Arg.*; EUPHORBIACEÆ. 215

THE CEARA RUBBER TREE: OR SCRAP-RUBBER TREE.

Full information will be found regarding this tree, in Vol. IV., 374, under India-rubber, to which article the reader is referred.

M. utilissima, *Pohl.*; *Fl. Br. Ind.*, *V.*, *239*; also M. Aipi, *Pohl.* 216

CASSAVA, TAPIOCA, MANIOC.

Syn.—JANIPHA MANIHOT, *Kunth*; also of Sir W. Hooker, *Bot. Mag.*, *Table 3071*, *Vol. 58*; JATROPHA MANIHOT, *Linn.*

MANIHOT utilissima.

Introduction and Cultivation

These two plants, by some botanists, are regarded as separate species; by others the latter is deemed a variety of the former, if not at most a cultivated race only. It differs from Manihot utilissima, chiefly in the fact that it is not acrid to the taste and is, in fact, devoid of the poisonous principle of that species; hence it may be eaten fresh. On this account it is known as the sweet cassava, while the other form is the bitter cassava, which can only be eaten after having been specially prepared. But under each of these varieties, there are races or qualities of good and bad cassava which exhibit the effects of climate and soil, or indicate ancient cultivation. Thus, of Brazilian Tapioca, a writer in the *Planters' Gazette* says: "Now Rio tapioca is as much superior to the common flake tapioca as rice grown in Carolina is to rice grown in Moulmein or Arracan. Rio tapioca is also as much superior to the East India tapioca as Bermuda arrowroot is to potato starch."

Vern.—*Maravuli*, TAM.; *Marachini*, MALAY.; *Pulu pinan myouk*, BURM

References.—*Roxb., Hort. Beng., 69; Voigt, Hort. Sub. Cal., 158; Kurz, For. Fl. Burm., II., 402; Gamble, Man. Timb., 318; Dalz. & Gibs., Bomb. Fl. Supp., 77; DC., Origin Cult. Pl., 59; Grah, Cat. Bomb. Pl., 183; Mason, Burma & Its People, 507; Bidie, Cat. Raw. Prod., Paris Exh., 92; Ainslie, Mat. Ind., I., 428-430; O'Shaughnessy, Beng. Dispens., 559; Moodeen Sheriff, Supp. Pharm. Ind., 171; Flück. & Hanb., Pharmacog., 250; Bent. & Trim., Med. Pl., 235; Year Book Pharm., 1873, 185; Atkinson, Econ. Prod N.-W. P., Pt. V., 22-23; Drury, U. Pl., 265; Lisboa, U. Pl. Bomb., 270; Firminger, Man. Gard. in Ind., 124; Spons, Encyclop., 1828; Smith, Dic., 96; Treasury of Bot., 717; Simmonds, Trop. Agri., 349-352; Rep. Bot. Gar Ganesh Khand, Poona, 1882-83. 5; Madras Admin. Man., II., 135; Nellore Man., 114; Admin. Report, Andaman Islands, 1885-86, p. 53; Agri.-Hort. Soc. India (numerous papers & reports on Samples of Tapioca prepared, but the following are the more important): Trans. II. (1838), 215; Journals (Old Series) VII., 236-248; IX. (Sel.) 77; XII., 175; I (New Series) 184-191; VIII. (Proceedings, 1886), lxxxi.; Tropical Agriculturist I., (1881-82), 853; II., 189-191; V., 126; VII, 561.*

Habitat.—Reasoning on his usual triple lines, DeCandolle strongly supports the opinion that the Manioc is a native of America. All the wild species known in the world (42 in number) are found in America. Ancient historic evidence points to Manioc having been cultivated in America prior to the arrival of Europeans. The natives of America have several ancient names for the plant. Added to these facts the cultivation in Asia and Africa is unmistakably modern. But, on attempting to locate the habitat of the plant to narrower limits, DeCandolle admits that great difficulty exists. If we do not accept its origin as in eastern tropical Brazil, he says, we must have recourse to two hypotheses: either the cultivated Maniocs are obtained from one of the wild species, modified by cultivation, or they are varieties which exist only by the agency of man, after the disappearance of their fellows from modern wild vegetation.

CULTIVATION.

CULTIVATION. Assam. 217

INTRODUCTION INTO INDIA AND EXTENT TO WHICH CULTIVATED.

I. ASSAM.—It seems probable that the Manioc was actually introduced into India long before the earliest record of it in botanical books. It is not, however, mentioned by Linschoten in 1598, although that distinguished traveller and careful historian of Dutch and Portuguese influence in the East, goes into great detail regarding the yams which he saw in India. Voigt tells us that it "had never flowered in Serampore, nor had it done so in the Hon'ble Company's Garden, Calcutta, in 1814, though introduced in 1794 from South America." It was apparently first taken to Ceylon in 1786, from Mauritius, by Governor Van der Graaf. It is repeatedly men-

CULTIVATION. Assam.

tioned in the early numbers of the Transactions and Journals of the Agri.-Horticultural Society of India. The first detailed paper is that in Vol. VII. (Old Series) where the discoveries in Assam made by Jenkins, Hannay, and Masters, are reviewed. Hooker's account of the plant is also reprinted in the journal from the *Botanical Magazine*, and also Mr. John Bell's note, written in 1833, in which papers are detailed certain experiments in the cultivation of the plant in Calcutta, and the manufacture of Tapioca is discussed. Major Jenkins wrote: "The plant is very common, and Mr. Masters calls it the sweet 'Manihot'; that it does not contain the poisonous qualities of the South American plant, we may be sure, from the fact of the root being sold as a yam, and the Assamese eating it uncooked; they call it the *hemalú alú*, the leaves having some resemblance to those of the *simul* or *hímul* cotton-tree (**Bombax malabaricum**)." The Secretary of the Agri.-Horticultural Society, in replying to Major Jenkins, drew his attention to the fact that "Mr. Masters makes no mention of this plant in particular in his 'Memoir of some of the Natural Productions of the Angami-Naga Hills, and other parts of Upper Assam' (*Jour., VI., 34*), but that in his paper previously published (*Vol. IV., 197*) entitled 'Botanical Observations in Upper Assam,' he observes that **Janipha Manihot** ? the *Gash-alú*, is often used for hedges, and is not unfrequent in the jungles near the hills; it does not appear to have any poisonous qualities in a green state, as the Assamese eat the root eagerly when raw." This may be, the writer goes on to state, Major Hannay's *hemalú alú*. In a later communication Major Jenkins confirms that opinion, adding that *it grows all over Assam*, is constantly used for hedge-rows, but after two or three years the root is dug up to be eaten as yam, and is certainly quite harmless, as it is eaten raw. "I fear," continues Major Jenkins, "I could not send you the flowers; it seldom or never flowers. I at least do not remember to have seen it in flower, though I have always had some of the plants in my garden hedges. An old Assamese gentleman tells me he never saw the flower nor heard of it I may add that I have seen the same plant in Arracan." Major Jenkins also refers to having got from Dr Wallich plants of the West Indies Cassava, and that these were not distinguishable from the Assam stock. In still another communication Major Jenkins writes: "There is no barren waste or hill land about us in which this plant does not thrive; the root increases in size according to the period it is allowed to grow, from one to three or four years; and I suppose an ordinary-sized root may weigh from 10 to 20 seers, perhaps still more. I have never seen it cultivated in fields or plots, but it appears to be just stuck in the hedges (for which, whilst it grows, it forms a useful post), and when wanted, or at maturity, it is dug out. I think it is probable, as stated in Dr. Ainslie's work, that the plant is not indigenous to India. I do not recollect, at least, ever seeing it in a true forest or jungle." Dr. Falconer examined two specimens collected by Masters and reported: "The Indian plant has the palmately 5-7-parted leaves, glaucous underneath, of **Jatropha Manihot** or **Janipha Manihot**, and I believe it to be merely a variety yielding the 'sweet cassava.' The variety yielding the 'bitter cassava' we do not appear to have in India. The people of Bengal call the plant *roti alú* (bread-potato) and eat it raw without any bad effects. The plant has not flowered in the Botanic Gardens, at any rate there is no record of it."

Some fifteen years later, the Agri.-Horticultural Society published a paper communicated by Dr. A. C. Maingay from Malacca, in which, referring to Major Jenkins' statement that up to 1850 the Assam plant had not been seen to form flowers, he gave drawings and a detailed botanical description of the Malacca plant which he had fortunately found both in flower and fruit. He identifies it with "**Manihot utilissima**, *Pohl.*," and shows the

CULTIVATION. Assam.

fruit as 3 celled, 3 seeded, and as having 6 wings. The tapioca prepared from the root is of excellent quality, 'and there is already in the Straits Settlements a very large and rapidly increasing area devoted to its cultivation." The cultivators are wealthy Chinese who purchase tracts of forest land, destroy the trees, and grow the Manioc for a few years making very large profits. But the crop is an exhausting one, the soil soon begins to fail to yield a remunerative crop, the Chinese dispose of their purchases and migrate to new tracts, leaving the land so severely injured that, Dr. Maingay estimated, it would take 80 years before the indigenous growths would again cover the land While thus deprecating a too extensive destruction of forest in order to foster tapioca cultivation, Dr Maingay furnishes useful information as to the yield and methods of manufacture. Commenting on the subject of the difference between the sweet and the bitter Manioc, he says: "It is a fact adduced by all classes of cultivators with whom I have conversed on the subject, that in planting from cuttings, they must on no account be inverted. If by accident this occurs the resulting tubers do not belong to the variety described as the sweet, but to that to which in the West Indies I imagine the term 'bitter cassava' has been applied. The effects produced by eating these without prolonged steeping and washing are giddiness and vomiting, but as their taste is sufficiently bitter to act as a warning, such unpleasant results seldom occur."

"Though the bitter cassava, a plant considered botanically identical with the present species, is highly poisonous, unless exposed to heat, it may not be generally known in India that it forms the basis of the famous West Indian stew called 'pepper pot,' and that it also enters largely into the composition of several kinds of sauce."

II. Burma.—Many writers, like Major Jenkins in the passage quoted above incidentally allude to Manihot as existing in Burma, both under cultivation and in a state of naturalisation. Mason, for example, says "I am not aware that either tapioca or cassava is manufactured in Burma, but Manihot, the plant which produces both, is frequently seen in culture The natives boil the root and eat it like a yam, though severe sickness is often induced by the use of it. The Karen name signifies 'tree yam,' and in the Burmese it is called the 'Penang yam,' which shews whence it was imported. Malays have told me that much of the sago and arrowroot which comes from Penang and Singapore is made from this plant, though the former is usually supposed to be prepared from the sago-palm; it is said that an acre of ground planted with the cassava tree yields nourishment to more persons than six acres cultivated with wheat." Kurz remarks that the plant is "generally cultivated by Burmans and Karens, especially in toungyas."

Andaman Islands. 219

III. Andaman Islands.—In the Administration Report for 1885-86 there occurs the following passage which would point to Manihot being a successful and important crop in these islands:—"Tapioca, as a vegetable, presents results more remarkable than even the Otaheiti potato; while the latter can be planted only at the beginning of the rains and ripens eight months later, after which the tubers will not keep for any length of time, the former can be planted out at any time of the year. A shoot, thrust into the ground, will, at the expiration of eight or ten months, produce an average weight of 5lb of tubers, or no less than 8,000lb per *bigha*, allowing a space of 3' × 3' per each plant."

Madras. 220

IV. Madras Presidency.—The Manioc is now so widely cultivated in South India that it may be said to occur more or less in every district Ainslie (one of the earliest and most trustworthy writers on Indian medical subjects) says: "Having found that the Jatropha Manihot grew in great abundance and luxuriance in many parts of Lower India, I, some months before

of Manioc. (*G. Watt.*) MANIHOT utilissima.

CULTIVATION.

leaving that country, in 1814, attempted to make tapioca from the root, and perfectly succeeded, the first, I believe, that ever was made in our Indian dominions." He then remarks: "The tapioca plant is called in Tamul *maravullie*, and, from the circumstance of its having no Sanskrit, Arabic, or Persian name, I am led to think that it is not a native of Hindustan, but was probably brought hither, many years ago, by the Portuguese." While giving the prepared article a Tamul name, it is somewhat significant that Ainslie should make no mention of its cultivation in Madras. As grown on the Coromandel coast, the plants are said to be "more fibrous, and, therefore, inferior to those raised in Malabar." In the Nellore District Manual the plant is said to be the *Manupendalam* of the Telegu people. It is, however, in Travancore that the cultivation of this plant has assumed the greatest proportions. In the Madras Manual of Administration (*II., 135*) it is stated of that district that, within the last few years, the cultivation of tapioca has so extended that it has become a staple article of food. The following passage from the *Tropical Agriculturist* (*April 1882*), and which appeared originally in the *Journal of Applied Science*, deals mainly with the subject of Travancore Tapioca:—"The bitter cassava or tapioca plant (**Manihot utilissima**), which is a native of South America, is now largely grown in Travancore, where the soil seems so well suited to its cultivation as to warrant a still more extended growth. It is stated that, as the price of rice has risen of late years, tapioca has become the more essential as an article of food. It will grow in any soil, and needs but little care, except to preserve it from the depredations of cattle. After the roots are dug, the stem is cut into pieces about 4 inches long and planted some 3 feet apart, with a little ash or other manure. The root requires occasional weeding and earthing, and arrives at maturity in nine or ten months. Well boiled it is eaten with fish curry. It is sometimes given to cattle. In a green state the root does not keep long, but it can be sliced and dried in the sun, or grated and made into farina. A field of this valuable and nutritious root is planted at but little cost; its yield is very large, and its cultivation highly profitable. The produce has been estimated in Ceylon at 10 tons of green roots per acre; this weighs one-fourth when dried, and if the dried roots gave half their weight of flour, it would amount to 2,800lb per acre. With some care and attention any amount of the granulated flour might be prepared for home use and export, but though this plant grows almost wild, the people do not take the trouble to prepare it."

Bombay. 221

V. BOMBAY.—Graham (*Cat. Bomb. Pl. 183*) says this plant is "easily cultivated, growing equally well in any soil or situation. It is said to have been first introduced by the Portuguese at Goa, and is now pretty common in Bombay gardens, but simply as an ornamental shrub; the natives do not seem to be aware of the uses to which it can be applied, and if they were, could only be driven to them by a scarcity of their common and inferior articles of food, afforded by the Cucumber and Arum tribes." Dalzell & Gibson write: "About 22 years ago" (? 1849) "attempts were made by the Agri.-Horticultural Society to extend the growth of this plant as useful for food, but the experiment, as might have been expected in a great bread-corn country like this, failed, since the produce is by no means equal in nutritive property to that of our numerous cereals."

N.-W. P. & Oudh. 222

VI. NORTH-WEST PROVINCES & OUDH.—Mr. Atkinson (*Econ. Prod., Pt. V., 22-23*) remarks that the plant grows luxuriantly in these provinces. He then quotes from the Journals of the Agri.-Horticultural Society the process of manufacture as given in some of the papers here reviewed. No further information is available regarding these provinces, but Mr. Atkinson gives certain facts about Bengal.

CULTIVATION. Bengal. 223

VII. BENGAL.—The following passage from an interesting letter addressed to the Government of India (in September 1887) by Mr. R. Mitchell, Emigration Agent, Calcutta, gives much useful information regarding cassava and yam cultivation in Bengal:—"I am more anxious about the introduction of the sweet cassava, as a means of sustenance for the poorer classes, because it yields large returns under the most primitive cultivation, especially in light friable soils, and flourishes in the poorest land, where yams or sweet potatoes will not yield any return commensurate with the labour spent on them.

"The cassava stands drought well and thrives where every root crop languishes for want of moisture, but it cannot resist cold, and the leaves drop at once when touched by the frosty air of December, although the stems retain their vitality. In arenaceous soils, such as are to be found in the neighbourhood of Calcutta and most of the delta of the Ganges, the cassava stick merely requires to be cut into lengths of twelve inches, pointed, and thrust into the soil at an angle of about 60°, the ground occasionally cleared of weeds for the first two months, when the plant takes full possession of the soil and its vigorous growth destroys everything under it.

"The green tops are excellent food for cattle, the stems would make inferior firewood, being too slight and brittle to be used for any other purpose, while the roots provide the most delicious and wholesome food. Roasted they taste like chestnuts and, properly boiled, they are much to be preferred to indifferent potatoes. The only fault about the sweet cassava is that it will not keep. It must go from the garden to the pot, if possible the same morning; and the day after it has been dug, it becomes hard, woody, and unfit for food. It can be grated, however, and exposed to the sun, or dried on heated plates and made into flour, when it will keep an almost unlimited time, or it may be readily converted into starch.

BURMA. above incidental

"The bitter cassava is more hardy than the sweet, and yields a much larger return per acre, but the prussic acid contained in it must be got rid of before it becomes an article of diet. This is accomplished by pressing and exposure to fire on an iron plate.

"In January next, I shall be in a position to supply you with sufficient sweet cassava stems to plant an acre. I am also trying experiments in the Hills with this plant and will let you know the result at a later date."

The following, Mr. Atkinson says, is a mode of extracting tapioca from the roots pursued in the Lower Provinces:—"The roots are first washed and stripped of the rind, then ground to a pulp, which is thrown into a clean cloth, and the acrid poisonous juice well wrung out. The pulp thus partially deprived of its impurity is exposed for a few hours to the influence of the sun, by which any remaining juice is successfully taken up. The mass is next mixed with clear water, strained, and the pulp thrown away. The milky substance thus obtained is allowed to settle, when the clear water is carefully drawn off, and the subsidence again and again watered until it becomes perfectly firm and white; it is then put in the sun until quite dry, crushed, and passed through a muslin sieve." Much after the same fashion as in the above quotation, the information regarding Bengal tapioca is incidentally alluded to by the most unlikely authors. Firminger, for example, says: "The plant thrives well in Bengal, and a considerable plantation of it is raised annually in the garden of the Agri-Horticultural Society, though the manufacture of the tapioca is rarely, I believe, resorted to in India. The season for taking up the roots is in January, at the same time that cuttings are put down for the crop of the following year."

of Manioc. (*G. Watt.*)

MANIHOT utilissima.

MOST SUITABLE METHOD OF CULTIVATION.

CULTIVATION.

Mr. J. P. Langlois (No. 5 of the Series of Gardener's Notes published in the Agri.-Horticultural Society's Journals), gives the following directions regarding this plant :—

Soil. 224

"*Soil.*—The plant will thrive in any soil, although a sandy loam is the best.

"*Cultivation.*—It requires no cultivation whatever, and is occasionally met with in Arakan, growing wild in the jungle.

Propagation. 225

"*Propagation*—By cuttings. Care should be taken to use the stronger branches. The cutting must be from two to three feet long, to be placed in the ground in an upright position, and in rows, four feet apart.

Preparation. 226

"*Preparation.*—Twelve months after planting, the roots are fit to be dug up. They must then be well washed, and put into a trough with water, in which they are allowed to remain six hours, when the outer bark will be easily removed by a pressure of the hand. The next process is to grate the roots, and then press out the milky juice, which is poured into a flat tub. This is now suffered to rest for eight hours, when all the flour will subside to the bottom. The water is then poured off and the meal laid upon wicker frames to dry in the sun, for two or three hours. The flour is then placed upon hot plates, and well stirred, to prevent it burning.

"The heat will cause the amylaceous substance to coagulate into small irregular lumps of a transparent and gelatiniform colour. The tapioca is then ready for use. This is the best mode of preparing Tapioca and is that pursued in Mauritius." Simmonds writes :—"No less than 30 varieties of Mandioc are grown in Brazil, and of all the crops it is the one that gives the best return and the least trouble."

CASSAVA AND TAPIOCA.

MANUFACTURE OF TAPIOCA.—In addition to what has been said under the paragraph "Bengal," as well as in Mr. J. P. Langlois' account, the following facts may be given regarding the manufacture of tapioca :—"The tubers, each weighing from 10 to 25lb, to which they attain in from 18 to 20 months, are first scraped and then carefully washed by hand labour or by placing them in a rotatory drum exposed to a stream of water, by which all impurities are removed. After this they are reduced to a pulp by being passed through rollers. This is carefully washed and shaken up with abundance of water until the farina separates and passes through a very fine sieve into a tub of water placed beneath. The flour so obtained undergoes eight or nine washings, as upon the care with which these are conducted depend very much its whiteness and price in the market. It is now collected into large heaps, placed on mats, and bleached by exposure to the sun and air. It is finally converted into the pearl tapioca of commerce, by being placed in a cradle-shaped frame covered with canvas cloth, in small quantities at a time, slightly moistened, and subjected to a rotatory movement. The mass gradually forms into small globules, each about the size of a No. 6 shot. Whilst still soft, these are taken out and dried in the sun, and lastly, while constantly stirred, are fired in a large shallow iron pan, which is occasionally rubbed on the inside with vegetable tallow, after which they are packed in bags ready for exportation." We cannot afford space to deal with this subject more fully, but the reader is referred to the numerous works quoted in the paragraph of References, more particularly to an article on Malacca Tapioca (*Tropical Agriculturist, II., 189*), which greatly amplifies what Dr. Maingay wrote and brings his account of the process up to modern times.

MANUFACTURE. Tapioca. 227

CASSAVA.—The meal known as Cassava is only a cruder preparation than Tapioca. It is obtained by subjecting the grated root to pressure, to

Cassava. 228

MANUFACTURE. express the juice, and then drying and pounding the residual cake. Of this meal cassava cakes are made. These are prepared by gently heating the moistened meal, forming cakes of it, and then drying them in the sun.

Tapioca Meal. 229 TAPIOCA MEAL.—Is the precipitated starch from the expressed juice (described above under Tapioca) dried in the air without being roasted. It is the heating of the damp starchy precipitate that gives to tapioca its peculiar character. By this process the starch granules are swollen, many of them being burst and then agglutinated into rounded masses. A change is thus effected by which the starch of tapioca is rendered partially soluble in cold water, and in boiling water it forms a jelly-like mass.

MEDICINE. Tapioca. 230 Medicine.—The effects and uses of TAPIOCA are similar to those of starch. Speaking of the poisonous property of the plant, Sir W. Hooker wrote :—"It yields an abundant flour, rendered innocent indeed by the art of man, and thus most extensively employed in lieu of bread." "Such is the poisonous nature of the expressed juice of the Manioc, that it has been known to occasion death in a few minutes. By means of it, the Indians destroyed many of their Spanish persecutors. M. Fernier, a physician at Surinam, administered a moderate dose to dogs and cats who died in a space of 25 minutes, passed in great torments." "Thirty-six drops were administered to a criminal. These had scarcely reached the stomach, when the man writhed and screamed with the agonies under which he suffered, and fell into convulsions, in which he expired in six minutes." The poison contained in these roots has long been known to be Hydrocyanic acid.

Manilla Hemp, see Musa textilis, *Nees;* SCITAMINEÆ; p. 302.

231 ## MANISURUS, *Linn.; Gen. Pl., III., 1130.*

A name which denotes the resemblance of the spikes to a lizard's tail.

[*Econ. Prod., III., 424;* GRAMINEÆ.

232 **Manisurus granularis,** *Swartz.; Duthie, Fodder Grasses, 29; Dict.*

Vern.—*Trinpali,* HIND.; *Kangni,* AJMIR; *Dhaturo ghas,* RAJ.; *Agimali-gadi,* CHANDA; *Ratop,* BERAR; *Palanggini,* SANS. (according to Ainslie).

References.—*Roxb., Fl. Ind., Ed. C.B.C., 118; Ainslie, Mat. Ind. II., 434; Drury, U. Pl., 287; Dals. & Gibs. Bomb. Fl., 300; Grah., Cat. Bomb. Pl., 234; Coldstream, Grasses of S. Pb. Pl., 14; Trimen, Cat. Ceylon Pl., 107; Dymock, Mat. Med. W. Ind., 856.*

Habitat.—A hairy, annual grass, recognisable by the globular shape of the sessile fertile spikelet of each pair. According to Duthie, it is found on the plains of Northern India, ascending the Himálaya to altitudes of 5,000 feet. Roxburgh simply remarks that it grows amongst bushes: Dalzell & Gibson say it is very common on barren land.

MEDICINE. Plant. 233 Medicine.—The only author who deals with this subject is Dr. Ainslie, all other writers having repeated his words without either adding to, or even confirming, the accuracy of the original observations. Even Ainslie simply says that the PLANT was shewn to Dr. F. Hamilton while in Behar, as a grass prescribed internally in conjunction with a little sweet-oil in cases of enlarged spleen and liver. It may be added that it is somewhat significant, however, that this Behar drug, if it be such, is not mentioned by Irvine in his *Materia Medica of Patna.*

FODDER. Plant. 234 Fodder.—Mr. Coldstream states that "it is not much relished by cattle. It is both grazed and stacked, but opinions differ as to its qualities. It is supposed to last five or six years in stack." Mr. Duthie adds that in Ajmir it is considered a good fodder grass.

MANNA.

235

Manna.

Vern.—*Shirkhisht*, HIND.; *Shir-khisht*, BENG.; *Shirkhisht, bed-khist, shakar taghár*, PB.; *Gavanjbin*, BOMB.; *Ména*, TAM.; *Ména*, TEL.; *Kapurrimba, mannâ*, MALAY; *Terenjabiri, mun shir-khist, sukkarul-ghushar*, ARAB.; *Shir-khist*, PERS.

References.—*Roxb., Fl. Ind., Ed. C.B.C., 574; Brandis, For. Fl., 22, 145, 302, 512; Stewart, Pb. Pl., App. 93; Pharm. Ind., 136; Ainslie, Mat. Ind., I., 209, 613; O'Shaughnessy, Beng. Dispens., 278, 295, 434, 454; Moodeen Sheriff, Supp. Pharm. Ind., 37, 82, 171, 239; Dymock, Mat. Med. W. Ind., 2nd Ed., 77, 218, 516; Dymock, Warden, and Hooper, Pharmacog. Ind., I., 161, 419, 583; Fleming, Med. Pl. and Drugs, as in As. Res. Vol. XI., 188; Flück. & Hanb., Pharmacog., 413; Hooper, Chem. Notes on Mannas; U.S. Dis-pens., 15th Ed., 1256; S. Arjun, Bomb. Drugs, 16; Kanny Lall Dey, Indigenous Drugs of India, 70; Waring, Pharm. Ind., 136; Linschoten, Voyage East Indies in 1598, II., 100; Irvine, Mat. Med. Patna, 101; Honigberger, Thirty-five years in the East, Vol. II., 305; Baden Powell, Pb. Pr., 320, 361; Royle, Ill. Him. Bot., 275; Smith, Dic. Ec. Pl., 265, 401, 402; Davies, Trade and Res. N.-W. Frontier, pp. cxx, cxxvii, ccxcvi; Balfour, Cyclop., III., 852-3; Encycl. Brit., XV., 493; Treasury of Bot., II., 718; Indian Forester, XIII., 93; Hanbury, Historical Notes on Manna (Jour. Pharm. Soc. XI, 1870), 326 (also in Science Papers, p. 355); Aitchison, Trans. Linn. Soc. (2nd Ser.), Vol. III., 3, 42, 64; Aitchison, Plants and Plant Products of Afghánistán, Pharm. Soc. Gr. Brit., 8th December 1886.*

This is a saccharine exudation obtained from several plants naturally, and from others on the bark or epidermis being incised. This subject has been dealt with to some extent under **Fraxinus ornus**, *Linn.*; Vol. III., 442-443.* The facts there given will not be repeated here, and as the MANNA chiefly used in India is imported, the subject has scarcely more than a scientific interest. The following are the plants reported to yield the substance:—

Alhagi camelorum, *Fisch.*; **A. maurorum**, *Desv.*; } Vol. I., 165; Vol. III., 443.
Astragulus, sp. in Persia.
Atraphaxis spinosa, *Linn.*; Vol. III., 443.
Calotropis gigantea, *R. Br.*; Vol. II., 37, 47; Vol. III., 443.
Cedrus Libani, *Barr.*; Vol. III., 443.
Cotoneaster acutifolia, *Linn.*; according to **Aitchison.**
C. nummularia, *F. et M*, Vol. III., 443.
Fraxinus ornus, *Linn.*; Vol. III., 442-444.
Musa superba, *Roxb.*; p.....
Palmæ, various species.
Pinus excelsa, *Wall.*; Vol. III., 443; Vol. VI.
Quercus incana, *Roxb.*; Vol. VI.
Rhododendron arboreum, *Sm.*; Vol. III., 443.
Tamarix sp, Vol. VI.
Salix sp., according to **Stewart.**
Salsola fœtida, *Del.*; according to **Stewart and Aitchison**; Vol. VI.

One of the earliest, and at the same time most interesting, accounts of Indian Manna (written by a European) is that which occurs in the Journal of **John Huyghen van Linschoten's** Tour to the East Indies in 1598. "Manna," he says, "commeth out of Arabia and Persia, but most out of the Province of Usbeke, lying behind Persia in Tartaria: the manna yt is brought from thence in glasse kalles, is in peeces as bigge as preserved almonds, but of another fashion, and have no other speciall form, but like

* Please correct two misprints in Vol. III., page 443:—For **Araphaxis** read **Atraphaxis.** Cancel the words "samples have" in line 21 from the top.

broken peeces: it is whitish, and of taste almost like sugar, but somewhat fulsome sweetish like hony: the Persians cal it Xercast and Xerkest, that is to say, milke-of-trees, for it is the dew yt falleth upon the trees, and remayneth hanging upon the leaves, like water that is frozen and hangeth in drops at gutters and pentises. It is then gathered and kept in glasse kals and so brought into India and other countries, for in India they use it much in all sorts of purgations.

"There is another sort of Manna called Tiriamiabūn or Trumgibūn* which they gather from other leaves and hearbes: *that* commeth in small peeces as big as Hempe seed and somewhat bigger, which is red and of a reddish colour. Some thinke this manna groweth on the bodies of the trees as Gumme doth: it is much used in Ormus and Persia for purgations, but not in India so much as the first sort.

"There is yet another sorte, which commeth in great peeces, with the leaves among it; it is like the manna of Calabria; this is brought out of Persia into Bassora and so to Ormus and [from thence into] India, and is the dearest of all the rest. There commeth also a Manna [that is brought] in leather bags or flasks, which in Turkey and Persia they use to ride withall and is melted like Hony, but of a white colour and in taste like the other sortes of Manna, being altogether used for purgations, and other medicines."

The Manna known to Muhammadan writers as *Taranjabín* is obtained from **Alhagi maurorum**. Mir Muhammad Husain says of this, that is collected in Khorasán, Mawarunnahr, Kurjistan, and Hamadan, and that the plants are cut off, then shaken in a cloth, to separate the Manna. **Dr. Aitchison** informs us that the country around Rui-Khauf is famous for its *Taranjabín*, and that, in addition to that obtained by shaking the bushes, an inferior sort is prepared by washing the twigs and boiling down the fluid. **Aitchison** regards *Taranjabín* as more digestible than *Shirkhisht*. According to **Dymock** fine clean samples of *Taranjabín* are sometimes obtainable in Bombay during the season of import (November to January), but unless very carefully preserved, it soon spoils, running together and becoming a brown sticky mass.

Shirkhisht is probably, as stated by **Moodeen Sheriff**, a generic name in India for any form of Manna, being that by which the imported European article is sold in the bazárs. Its Persian usage has a specific meaning, however, being the Manna from **Cotoneaster nummularia**. **Mir Muhammad Husain** points out that *Shirkhisht* or *Shirkhushk* is not, as generally reported, a honey dew which falls upon the trees in Khorasán, but is an exudation from the tree called Kashira—a small tree with yellow mottled wood, much valued for making walking sticks.

Gasangabín is the name which very probably should be restricted to Tamarisk Manna, though it is generally used as synonymous with *Shirkhisht*. **Dr. Aitchison** found that **Tamarix gallica**, not **T. mannifera**, was the source of this substance. **Dr. Fleming** wrote in 1810 that Alhagi manna was then regarded as far inferior to the Calabrian. He gives *Shirkhisht* as the Persian and *Terenjabín* as the Arabic names for manna.

Honigberger describes *Turunjebin* and *Shirkesht*, but adds that a manna obtained in India is known as *Tighal*. This, he says, is what the Sadus at Lahore import from Hindustan and sell by the name of *Shukurf Tighal*. He concurs with **O'Shaughnessy** in thinking this may be obtained from **Calotropis gigantea** or some nearly allied plant.

Chemistry.—**Dr. Warden** of Calcutta has kindly furnished the following note on the chemistry of this substance:—The chief constituent of manna is

* *Shirkhisht* and *Taranjabin* are Persian names for two kinds of Manna.

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mannite or mannitol, a hexahydric alcohol discovered by Proush in 1806. Mannite is found in the sap of many plants and also in fungi. It is crystalline, and only slightly sweet to the taste. It does not reduce an alkaline cupric solution: it slowly ferments with yeast. A mixture of concentrated nitric and sulphuric acid converts mannite into a hexanitrate, which is explosive on percussion. Mannite also gives rise to several other derivatives when treated with certain other acids. Under the oxidizing influence of platinum, black mannite is converted into mannitic acid, and, according to Hanbury & Flückiger, also into mannitose, a sugar probably isomeric with glucose. By the action of nitric acid it is changed into saccharic acid. In the best specimens of manna from 70 to 80 per cent. of mannite occurs. Dextroglucose, water, a very small amount of reddish brown resin with offensive odour and a subacid taste, and a substance called fraxin are also among the constituents of manna. Solutions of certain samples of manna exhibit a fluorescence which was attributed by Gmelin to the presence of æsculin, the fluorescent glucoside contained in the bark of the horse chestnut, but Flückiger & Hanbury state that the fluorescence is due to fraxin, a body closely resembling æsculin, and occurring not only in the bark of the manna and common ash, but also, associated with æsculin, in that of the horse chestnut. Stokes, on the other hand, describes a second fluores, cent principle as being associated with æsculin in thehorse chestnut, which he has named panin. Flückiger & Hanbury describe fraxin as being faintly astringent and bitter, and soluble in water and alcohol, Dilute acids convert it into fraxetin and glucose. Madagascar manna, obtained from Melampyrum nemorosum, contains an isomeride of mannitol, melampyrite, dulcite or dulcitol. This principle is also contained in the sap of other plants. It may be artificially produced with mannitol, when a solution of milk and sugar which has previously been boiled with dilute sulphuric acid. is treated with sodium amalgam. It is crystalline and scarcely sweet. Nitric acid converts it into mucic acid, which is isomeric with saccharic acid It forms compounds with acids (*Graham*). Since the above was written an interesting note on the chemistry of mnnna by Mr. David Hooper, F.C.S., has appeared, to which the reader is referred for further information.

(*W. R. Clark.*)

MANURES.

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Manures and Manuring.

Vern.—*Khad, khau, eru, paus,* HIND.; *Khádar, khadaur, khaddhi, gondaura, goa, karsi, ghár, gánaura,* BEHARI; *Páus, páusá, khát,* N.-W. P.; *Kurri khár, khát kúra, kallar, sarra,* PB.; *Pánsu,* SANS.; *Zibl,* ARAB.

References.—*Liebig, Natural Laws of Husbandry, 131 et seq.; Anderson, Agricultural Chemistry, 152-265; Johnston, Agric. Chem. and Geol., 198 318; Baden Powell, Pb. Pr., I., 95, 204, 205, 214, 416; Benson Manual and Guide, Saidapet Farm, Madras, 19—34; Wallace, India in 1887, 79-84, 224, 285; Hove's Tour in Bombay, 118-119; Schrottky, The principles of Rational Agriculture applied to India, 106-156; Annual Report, Agric. Dept., Madras, 1878, 24-29, 87-99; 1882-83, 64-65; 1883-84, 37-46; Annual Reports, Madras Experimental Farms, 1872, 34-41; 1873, 26-28; 1875, 31-36; 1877, 32-37, 98-102; Annual Report. Dept. Land Records and Agric., 1887-88, 18-19; Settlement Reports:—Panjáb, Bannu Dist., 83, 84; Montgomery District, 101; N.-W. P., Azimgarh, 101; Banda District, 55; Central Provinces, Upper Godavery District 28; Annual Report of Director of Agric. Dept., Bengal, 1885-86, App. I., iii-v, ix, xxx-xxxiii; Gazetteer:—Bombay, VII., 79-91; VIII, 179; Agri.-Hort. Soc. Ind., Transactions, I., 20, 29, 42, 59; III., 185, 186; Journal I., 207, 295-296; V, Part I., 19, 101; Part II., 20-23, 44-60; X., Part-I., 92-94; XIV, Part I., 133-135, 198; Spons, Encycl., II., 1256-1277; Encyclop. Brit., XV., 505-512; Balfour, Cyclop. Ind., II., 858-859.*

In India, systematic manuring has practically been neglected by the

Natives. They have been accustomed, from father to son, to carry on the same rough system of manuring, collecting for that purpose merely such substances as are inexpensive and easily obtainable. Not only this, but they have also, by the almost universal use of dried cow-dung as fuel, and, by the custom of allowing the urine of their cattle to run to waste through insufficient littering, neglected the most important source of manure and the one that lay readiest to their hand. Caste prejudices, too, have to a great extent forbidden the employment of the night soil of large towns, hence depriving the Natives of India of that important supply of valuable manure.

Various attempts have been and are being made by Government, and by the municipalities of the cities, to educate native cultivators to an intelligent conception of the value of manures, and large quantities, both of natural and of artificial manures, are used by the European planters in India; but neither the example of these, nor the precepts and efforts of the Government, have as yet done much to arouse the Native to a sense of the benefits arising from the systematic use of manures.

ANIMAL MANURES

In dealing with the Manures available in this country, we shall divide the subject into three classes—Animal, Vegetable, and Mineral.

I.—Animal Manures.

Farm-yard Manure. 238

(1) **Farm-yard Manure.**—Although this is the most valuable manure and most easily available to the agriculturist, yet no attention is given by the Natives generally to its collection and due preservation. Most of the Natives keep cattle, but they take no care that their droppings and urine are preserved. The droppings are in most cases sun-dried and used as fuel (*bratti's* or cow dung cakes); while the urine, through want of litter, is allowed to soak into the floors of the cow sheds and places where the cattle are picketed, and so is very generally lost. The practice of manuring is almost entirely confined to gardens, especially the large market gardens around cities, and some portions of irrigated lands, where particularly exhausting crops, such as sugarcane and tobacco, &c., are grown. No manure pits are formed, hence the manure usually applied to these grounds, except in the vicinity of towns where night-soil is procurable, and where the religious scruples of the native agriculturist do not prevent its use, are village ashes, weathered, sun-dried cattle dung, and the manure supplied by the folding of cattle and sheep on the land at night. During the day these feed anywhere on waste land where they can pick up a bite; and as they get no addition to the food thus obtained, it may be admitted that their excreta can hardly fail to be of poor quality. The native Indian agriculturist, although he appreciates the value of sheep folding, rarely thinks of raising green crops to be eaten on the land. The statement made by some agricultural authorities, that the use of cattle dung for fuel does not cause any loss, since the ashes made by the combustion of the dung are quite as efficacious a manure, seems to the writer to be but an attempt to revive the old "mineral theory" exploded forty years ago. Bulk and dilution are within certain limits essential for the utilization of a manure, and hence the superiority of farmyard manure over ashes. Further, when the solid excrements of cattle are collected for fuel, the urine is always lost, a large proportion of the ashes is wasted, and the fertilising properties of the portion actually used as manure are seriously lessened by the careless way in which the ashes are stored. From the Annual Report of the Superintendent of Government Farms (Madras) for the year ending 31st March 1875, the following interesting extract on the subject of farmyard manure may be quoted:—

CHEMISTRY 236

"It is a mistake to suppose that the fertilising effects of farmyard manure can be measured, and determined by its composition as shown by analysis. Field experiments have shown over and over again that one ton of

ANIMAL MANURES.

Farm-Yard Manure.

farmyard manure when applied to the soil, will produce vastly greater effects than a dressing of mineral manure containing the ash equivalents of the ton of manure. While the effect of the ashes on the physical state of the soil would be almost imperceptible, that produced by the farmyard manure would be great and highly beneficial. In no country would the benefits that are conferred on a soil by an application of farmyard manure be greater than in India, where famines so frequently result from a drought. The power of a soil to absorb moisture from the air and to retain that moisture in a healthy condition depends almost entirely upon the quantity, and state of the organic matter that soil contains, but, with reference to this matter, I cannot do better than direct attention to the statements made by the late **Professor Voelcker** in a report upon plots of land which had for many years been manured by one kind of manure only. Speaking of the plot that had continuously been manured with farmyard manure, he says:—'Dr. Gilbert informs me that whilst the pipe drains from every one of the other plots (dressed with mineral manures) in the experimental wheat field run freely four or five or more times annually, the drain from the dunged plot seldom runs at all more than once a year, and in some seasons not at all. The fact is, the accumulation of decomposing organic matter in the plot lightens the soil, promotes the disintegration of the clayey portions, and altogether renders the surface soil more porous, and capable of retaining much more water.'"

The improved sanitation of India, which has to such an extent checked the outbreak and spread of the epidemics that were wont to decimate the people, and has thus been instrumental in increasing the population, loses its chief merit if coincident poverty takes place through deficient food supply. If the food produced in the country (through expansion of cultivation and improvement in yield) is to keep pace in its increase with the increasing population, all practices that tend to lessen the food-producing powers of the land should be checked, and none more necessarily so than the burning of cow-dung as fuel, a custom which deprives the agriculturist of his cheapest and most easily available source of manure.

Town Refuse. 239

(2) **Town Refuse.**—Night-soil and refuse from towns and villages is another valuable source of manure generally neglected by the Indian agriculturist. Although he is to some extent aware of the value of night-soil as a manure (witness the fact that "land close to the village site which is frequented by the villagers for purposes of nature is rented at three times the rate at which land near the boundary of the village is rented," **Mr.** (now Sir) **E. C. Buck** in a report on the employment of city refuse for agricultural purposes at Furrukhabad), still the Indian agriculturist allows an enormous loss of fertilising matters, especially throughout the villages and rural districts, by not collecting human excreta and the waste materials from habitations and utilising those fully as manure. The excreta deposited around human dwellings, both on cultivated and on uncultivated ground, dry up quickly and lose a great part of their fertilising powers, while the ashes and sweepings from the villages, which might be utilised to mix with and deodorise the excreta, without interfering with the manural properties, are simply heaped about, no effort being usually made towards their utilisation.

In large towns, of course, the excreta and other waste materials are always collected and removed from human habitations, but in such cases they are too often simply buried in the ground at some convenient locality and thus lost to the cultivators generally. This must be a serious loss to the agriculturist, since we may roughly calculate that the solid and liquid excreta of each individual, produce per annum about 6lb of ammonia and 3lb of phosphates. even after a due allowance has been made for the poverty of the food of the people in India.

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Town Refuse.

The question of the disposal of night-soil and its utilisation for manural purposes is one which has been, of late years, carefully considered by the various Provincial Governments, and many attempts have been, and are being, made by the municipalities of the large towns to induce the rayats to collect, and remove, to their land, the excreta of town populations; but, even apart from their objections on the score of caste prejudices, they are not usually willing to do so on account of the unpleasantness of the work and the poverty of the stuff through its admixture with useless matters. The North-West Provinces and Oudh seem to have made most progress in utilising night-soil as a source of manure; but in the other provinces attempts are also being made in the same direction and with varying success. The Sanitary Commissioner of Bengal, in a recent note on the subject, commends the shallow temporary trenching on fields, pursued in Howrah, as a desirable system to be extended throughout the province. The fields thus manured may, he says, be cultivated within three months. But, in tracts of low-lying country subject to inundation during the rainy months, it seems questionable if that system could be followed during the rains.

In all the large cities, the night-soil is, of course, removed at the expense of the municipalities, and after removal the question arises as to how it can be most advantageously disposed of. In many places it is merely removed and buried in some convenient locality, but where attempts are made at utilising it, three courses are open (1) to trench it in, and lease the ground to cultivators, (2) to sell it after removal as manure, or (3) to convert [illegible] poudrette and sell the product thus manufactured. As a result of numerous experiments on the subject of the utilisation of night-soil in the various provinces, the following conclusions have been arrived at (1) that where there is plenty of available water ready at the right moment, and a sufficiency of cultivators who appre- full the value of trenching land with night-soil, the first means of dispo- is the most advantageous, since it not only repays the cost of removal, but also yields a clear income; (2) selling the night-soil and delivering it to cultivators at their fields at the largest price obtainable, or allowing sweepers to remove and dispose of it as best they can, both yielded the same result—neither profit nor loss to the municipality; (3) the poudrette system is the most costly of all since it requires a considerable outlay on the part of the municipality without yielding any corresponding income.

Animal Refuse. 240

(3) Animal Refuse.—This includes the blood, offal, and bones of the cattle and sheep which are slaughtered, the carcasses of domesticated and wild animals that die, and fish. As in the case of *Farm-yard Manure* and *Town Refuse* it may at once be admitted that the materials embraced under the present paragraph constitute another largely neglected means of preserving the fertility of the land. Mr. W. A. Robertson, in his report on some manural substances yet unutilised in this country, states that, in the Presidency of Madras alone, the amount of blood, offal, and bones of the sheep killed in that Presidency in the year 1871-72 would have been sufficient to manure highly 44,000 acres of land. Besides the diminution of stock by slaughter, there is annually an enormous loss from disease and other natural causes: the manural matters thus produced are, under existing circumstances, almost entirely wasted. Slaughter-house refuse is a highly nitrogenised manure, and would, therefore, be specially good for crops like sugarcane and maize. Fish manure also is scarcely ever utilised in this country, although large quantities of fish-oil are manufactured, the refuse from which, if properly conserved and utilised would form an invaluable substitute for guano, and not only prove a rich source of manure on our Eastern and Western Coasts, but also in time become a good marketable commodity and afford a livelihood to many

ANIMAL MANURES.

Bones. 241

poor people in these parts. Very occasionally in Bengal a manure of rotten fish is applied to the roots of trees.

(4) Bones.—By far the most valuable source of manure which is lost to the country proceeds from the non-utilisation of the various bone manures. All the different preparations of bone, whether boiled bones, crushed bones, bone black, or superphosphate, are very valuable to the farmer, from the amount of phosphoric acid they yield; but, in spite of this, they are never used by the ordinary cultivator in any part of India. This, in addition to the very prevalent religious objection, is partly on account of the expense that would be entailed in crushing the bones and dissolving them with sulphuric acid—the most valuable method of using them—and partly also to the vegetarian habits of the agricultural people of India, not creating in their immediate vicinity a large supply of bones. As an example of the well known benefits that would arise from the extensive use of some of the various forms of bone manure with Indian crops, we may quote a letter in the *Indian Agriculturist* of November 2nd, 1889, by Mr. B. C. Basu, Assistant to the Director of Land Records and Agriculture, Bengal. He says:—"I have obtained this year, on the Seebpore Experimental Farm, an absolute increase of 26 seers of cleaned jute over the usual produce of half a *bígha* of land with an application of 1 maund of bone meal. The latter may be made in the country at 12 annas a maund, while the value of the increase in yield cannot be less than R2-8." In Mr. C. Benson's Saidapet Experimental Farm Manual, page 28, there is a notice of a series of experiments made on the comparative value of different manures. Amongst others, bone-dust was used, with the result that 37lb of bone-dust valued at R1 caused an increase in a crop of Sorghum or Chinese sugar-cane of 48lb of grain and 420lb of straw, or a total increase per acre of 864lb of grain and 7,560lb of straw, valued at R45-8-3, giving a clear profit per acre of R27-8-3. In this series of experiments, saltpetre gave the best results; bone stood second on the list, but "probably," says the Manual, "if the continued effects of each were considered, bone-dust would stand first." In an interesting note on the use of and trade in bones in Bengal, prepared by Mr. B. C. Basu, an account is given of some experiments made, through rayats, to test the efficiency of bone-meal as a manure for paddy. The results of these were very encouraging as they showed an average increase of 570lb of paddy per acre by manuring with 240lb of bone-meal. "The money value of the increase in a year of ordinary prices may be taken as R9-8, while the price of 240lb of bone-meal applied per acre is only R6 at its present high price in Calcutta." "Until, however, bone-meal can be offered to the public at cheaper rates than oil-cake, there is no hope for its general adoption in native agriculture."

A considerable and increasing export trade in bones exists in India, which is not a matter of congratulation to the Indian agriculturist. In the year 1884-85, 18,383 tons of bones were exported from India; while in 1888-89 this trade had nearly doubled itself, 35,393 tons, valued at R17½ lakhs, having been exported during the latter period. As very nearly half the weight of a quantity of mixed bones is made up of phosphate of lime, we thus see that in the year 1888-89 alone, about 17,000 tons of calcium phosphate were removed from the soil and taken out of the country altogether. If this continues for many years, the result may be anticipated of a serious diminution in the already small proportion of phosphates which exists in the Indian soil. This export trade, however, is very far from representing the actual quantity of bones that must be available throughout India. According to Mr. J. E. O'Conor's Statistical Tables of the Foreign Trade of British India, in the year 1888-89, 6,606,142 undressed and 1,447,544 dressed hides, making a total of

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Bones.

8,053,686 hides, *i.e.*, skins of cows, bullocks and buffaloes, were exported to other countries. From this may be deducted 48,449 hides which were imported into India from foreign countries, during the same period, and which may or may not have been again exported, thus leaving at least a net total export of 8,005,237 hides of cows, bullocks, and buffaloes that were slaughtered or died in India during the year 1888-89. Assuming that the bones of an average sized cow, bullock, or buffalo weigh 80lb (*Benson, Saidapet Experimental Farm Manual, p.* 25), we have a total of 285,001 tons of bones from the cattle from which these hides were obtained. Besides this, a large quantity of hides is annually used in India for manufacture into leather, and the bones from these should also be available. But there is still a further source of bones, for India exports large quantities of dressed and undressed skins chiefly from sheep and goats, the bones of which animals should be a valuable source of manure since in the year under notice these skins amounted to over twenty-four millions. When a due allowance has been made for the bones of the animals represented by the hides and skins of commerce, even this estimate would not include the bones of the very large number of cattle that annually die in the villages and whose bodies are thrown into the nearest nullah or water-course, without either their skins or their bones being utilised, nor would it provide for the vast numbers of wild animals that die annually throughout the country and whose carcasses rot in every jungle; but it will suffice to show that, although a considerable export trade in bones is springing up, yet the figures of that trade by no means represent the amount of bones that are annually available as manure. At present, as already remarked, bones are not directly used for manure, in any form, by the ordinary Indian agriculturist. Indirectly, as they decay, a portion of their nitrogen and phosphorus finds its way into the soil; but this natural process is a very wasteful one. In some instances, caste prejudices debar the rayat from the use of bones, but even where this is not so, the conservatism of the Indian cultivator and the absence of any simple cheap method, by which bones may be crushed and reduced to the best form for application to the fields, have hitherto hindered the use of this manure. In the note (above mentioned) Mr. Basu gives details of a cheap method adopted by him for obtaining a supply of bone meal. He says:—"Raw bones may be bought in the Mofussil at prices not exceeding 8 annas a maund. They are then ground in a mortar with a heavy *dheuki* (or pestle such as is used for husking grain). With this appliance three men (two at the treadle and one at the mortar) made 20 seers of fine meal and 20 seers of roughly broken bones in five and a quarter hours. At this rate one maund of bone meal would be obtained in ten and a half hours. Taking a man's wages at 3 annas a day of eight hour, the cost of making one maund of bone-meal would be about 12 annas. To facilitate the work of grinding bones, they may be previously softened by some process of fermentation, for instance, by collecting them in a heap, moistening them with liquid manure and covering them over with stiff clay, from time to time moistening the mass with fresh liquid and allowing it to remain thus for 6 to 8 months, in the course of which time the bones will have become quite soft and fragile and can be easily reduced to powder."

Bone Mills. 242

Of late years, in Calcutta, Bombay, and Lahore, bone mills have been started, and thus both bone-meal and superphosphate are manufactured in India, but the present high price of these articles (R32 to R60 per ton) debars the native cultivator from employing them, and their use is as yet confined to experimental farms and the land occupied by English planters. A considerable quantity of the bone-meal manufactured in Calcutta and Bombay is exported to Europe.

ANIMAL MANURES. Guano. 243

(5) **Guano.**—One of the most important animal manures used in European countries is guano, which owes its value to the ammonia, phosphates, potash, and soda it contains, as well as other constituents of plants in small amounts, but in a readily available condition. Insignificant quantities of this valuable manure have been imported to India, for experimental purposes. It has been ascertained that it is very efficacious as an application for preventing sugarcane cuttings from being attacked by white-ants, while at the same time it affords that crop the food needed during its growth. The large expense entailed by the importation into this country of South American guano will always preclude its use by the Indian agriculturist, but efforts might be made to utilise deposits of guano which have been found in various parts of India, such as the bat guano of the caves in the Kurnool District, in Moulmein, and near Vizagapatam, and the bird guano in the Nicobar and Andaman Islands (see **Callocalia nidifica**, Vol. II., 508). Of the former, an experimental analysis was made by the Chemical Examiner of Madras, which showed that bat guano was particularly rich in ammonia; but its value as a manure is little recognised locally, and no records of its experimental use are available. Samples of the latter (bird guano) were sent to the Superintendent of the Botanic Gardens, Calcutta, for practical trial, but no information has been received as to the result of this experiment.

Guano, both from **Callocalia nidifica** and from bats, has, however, been extensively employed by Chinese agriculturists in the Malay Peninsula in the cultivation of the cocoanut, nutmeg, clove and *sirih* vine (**Piper Betle**) with good success, and it seems strange that the extensive supplies of this substance in India, alluded to above, are not made use of.

II.—Vegetable Manures.

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Various vegetable substances, such as the boughs and leaves of bushes and trees, indigo refuse, wood ashes, weeds of every description, green, dry, or burnt, oil cakes of various kinds, the soft deposits of tank beds containing all sorts of vegetable substances, are, to some extent, used as manures by the Natives of India. They are usually, however, simply thrown upon the land and dug or ploughed, into the fresh state, into the soil where, during decomposition, they very frequently form a nidus for insects of various sorts, which prove injurious to the living plants. Except by the market gardeners around large cities, no pits or heaps for the collection and maturation of vegetable manures are formed by the ordinary Indian agriculturist, and it is only what comes to his hand readily at the time that the peasant uses, and he almost never tries to gather together the vegetable refuse that falls during the year for utilisation at the proper season.

Green Manures. 245

(1) **Green Manures.**—Plants that contain a milky juice, such as the *madar* (**Calotropis gigantea**) and the milk-hedge (**Euphorbia Tirucalli**) are specially preferred by the rayat; but besides these, various other plants are favourite manures. A complete list of all that are so used is almost impossible, since it would include nearly every plant that grows wild in India; but the following are the principal and those that are most generally employed or are supposed by the Natives to have some special manural value:—

Adhatoda Vasica, *Nees.*
Calotropis gigantea, *R. Br.*
Cassia auriculata, *Linn.*
Cedrela Toona, *Roxb.*
Datura, (species).
Dodonea viscosa, *Linn.*
Euphorbia Tirucalli, *Linn.*
Holarrhena antidysenterica, *Wall.*
Indigofera paucifolia, *Delile.*
Jatropha Curcas, *Linn.*
Melia Azadirachta, *Linn.*
Mirabilis Jalapa, *Linn.*
Ocimum sanctum, *Linn.*
Pongamia glab-, *Vent.*
Solanum, (species).

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Adhatoda. 246

In his Selections from the Records of the Revenue and Agricultural Department, Government of India, Dr. Watt notes that the leaves of **Adhatoda Vasica** (see Vol. I., 100) are much used in the Panjáb as a vegetable manure for paddy fields, and he states that in the Sutlej valley they are believed by the cultivators to possess the additional virtue of killing the aquatic weeds that spring up after the fields are inundated and which would, if left alone, materially injure the crop. An enquiry was instituted by him to ascertain whether a knowledge of this alleged property of the leaves of **Adhatoda Vasica** was universal, and he found that they were almost always prized as a manure wherever the plant occurred, and in some districts their powers of destroying low forms of vegetable life were well known to the natives. (*Conf.* with remarks under **Oryza sativa**, Vol. V.)

Burning the Soil. 247

(2) **Burning of the Soil—Jumming or Rábbing.**—Burning of the weeds in heaps is less practised in India than in Europe, but the aboriginal tribes are fond of cutting down patches of forests and burning the trees, bushes, and weeds on the surface soil, preparatory to tilling the land for a temporary cultivation, which lasts for but a few years, when these predatory cultivators migrate to other scenes, where they may renew their extravagant system of culture. In Bombay and South India, a civilised modification of this system is pursued, where seed beds or even fields are prepared by a method of manuring there known as *rab*. This consists of burning the surface soil by means of layers of dried manure, leaves and branches, &c., then ploughing in the ashes. For a full account of this process the reader is referred to the article **Oryza sativa**.

Jumming. 248

Rubbing. 249

Indigo refuse. 250

(3) **Set.**—Indigo vat refuse (*Cont.* Vol. IV., 401) is largely used in some places as a manure; but as it is also employed for fuel in indigo factories, it is not always easily obtainable. Sometimes it is neither used as a manure nor as fuel; but simply allowed to waste,—a striking example of the carelessness of the ordinary cultivator with regard to his conserving of manures. In some parts of Bengal the refuse from indigo vats is thought a particularly valuable manure for the cultivation of tobacco, and is much sought after as such.

Green Soiling. 251

(4) **Green-soiling.**—This method, although very suitable for dry sandy soils where the summer crops are precarious, a condition of things largely prevalent over the greater part of India, is almost unknown to the Natives. In the various experimental farms the production during the summer of a crop of horse gram (**Dolichos uniflorus**), indigo (**Indigofera tinctoria**), or *sun* hemp (**Crotalaria juncea**), and the ploughing of this into the soil before the sowing of the winter crop, has proved vastly successful. It increases the outturn of grain in some cases by more than 70 per cent., and is much to be recommended for fields where farmyard manure cannot be applied with profit, owing either to long distance or to scarcity of manure. Although this method of "green soiling" seems to be so productive, it appears to be very little known to the Natives of India. Instances are mentioned in the Report on the Nagpur Experimental Farm for the year 1883-84, p. 13, where in the Chindwara District a crop of **Crotalaria juncea** was ploughed in, as a manure for sugar-cane, and **Professor Wallace** (in his *India in 1887*), speaking of the same crop, remarks:—"A green manuring is sometimes given as in Guzarat by ploughing in a crop like *tag*—**Crotalaria juncea**." **Baden Powell** also states that "in some parts of the Ambálah division a practice exists of occasionally growing a coarse kind of millet (**Panicum frumentaceum**) which is ploughed into the soil green as a manure." Green soiling appears to be used considerably among the Indian tea planters, as a means of increasing the yield of tea. Between the tea bushes they sow a crop of mustard in rows, and, when full grown and on the point of flowering, the mustard is dug into the ground between the tea

plants, covered, and left to decompose (*Indian Agriculturist*, June 16, 1888). In spite of its suitability to the climate and soil of India, no very extensive use, however, appears to be made of this system of manuring. The agriculturist, either through greed or the innate conservatism of his character, usually prefers his meagre hot weather crop, to any prospective augmentation of the winter one, by methods which do not bear the stamp of ancestral use. VEGETABLE MANURES.

(5) **Oil-cake.**—The use of the various forms of oil-cake as manures will be dealt with in another portion of this work (see **Oils & Oil-cakes** Vol. V.) Oil-cake. 252

III.—Mineral Manures.

Mineral manures, although occurring in many parts of India, are not used by the Natives generally. They may be enumerated thus:— MINERAL MANURES.

(1) **Lime.**—The use of lime as a manure is in India practically overlooked and perhaps fortunately so, for did the native agriculturist know its stimulating properties on a soil stinted of other manures, he would probably soon, by its help, liberate all the insoluble mineral substances in the soil, which in the natural state would have become slowly available to the plant, and thus anticipating the supplies of future years, leave the soil barren. The high price of fuel is a great obstacle to its use in India, but in the vicinity of large towns where accumulations of refuse exist, the lime might be burnt with these, and thus made available for agricultural purposes at a low cost. There is no doubt that with judicious management, many lands in India might be vastly improved by the use of lime; but it would be injudicious, in the present state of agriculture, to furnish the ordinary native agriculturist with so violent a stimulant for the land. As a manure for leguminous crops, lime, as well as the next manure of this series, gypsum, is very valuable. (*Conf.* with Vol. II., 151). Lime. 253

(2) **Gypsum.**—Sulphate of calcium, in the form of the refuse from the soda-water manufactories, has been used successfully as a manure on the Sydapet Experimental Farm in Madras. In this form it contains not only the pure sulphate of calcium, but also calcium carbonate, various chlorides, sulphates, and sulphurets of calcium and sodium, a mixture which is even more valuable as a manure, while in the neighbourhood of large towns it can be obtained at much less cost than pure gypsum. Gypsum. 254

The results of the application of gypsum in India have been very encouraging; the use of sulphate of lime in the Sydapet Experimental Farm so increased a crop that a clear profit of R14 was realised over what was gained on an unmanured crop, a result due entirely to the manure. Its use as a manure, however, is at present greatly checked by the high railway freight which is charged on it; but this would probably be at once remedied if it came into demand with cultivators. (*Conf.* Vol. IV, 195.)

(3) **Nitrates.**—The nitrates of potash and soda are both employed as manures in Europe, principally on account of the nitrogen they contain, although nitrate of potash is valuable also from the potash that it can supply to the plants. Nitrates. 255

In Europe the high price of nitrate of potash has prevented its general application, and, consequently, nitrate of soda has been used; but in India where a coarse nitrate of potash could be manufactured at a very low cost, there is nothing to prevent the use of the more valuable salt. It is of special value as a top-dressing, applied when the plants are one or two inches high, and such are its powers of increasing the yield, that in some experiments with chemical manures made at the Madras Model Farm, it was found that an application of one cwt. per acre nearly doubled the crop and gave the farmer a clear profit of thirty rupees over what was gained from a crop not so manured. It is said that the nitrates should be used

MINERAL MANURES.

Nitrates.

in grain crops combined with common salt, as the latter checks the tendency to run to straw; and since the common nitrate of potash contains chloride of sodium in considerable amount as one of its impurities, this would be the form most valuable to the agriculturist. Almost the same remarks, however, apply to the use of the nitrates of potash and soda as to that of lime. Used alone, they only act for one season or at most two, and they are mainly effective when employed on soils already well manured with organic substances. In England, nitrates are always employed when the weather is showery, and as the same atmospheric state is not available in India, the application of saltpetre without irrigation will not pay. To get its full value as a manure it should be applied on irrigated lands immediately after irrigation (*Ind. Agric. Gazette, 1887, 564*). In spite of the abundance, however, with which this salt occurs in India, it is little used by the native farmers. Many of them have learnt its value through the experiments on the various model farms throughout the country, yet their natural aversion to purchased manures and the fact that the manufacture of crude saltpetre can only be conducted under license, for which an annual fee is charged, prevent their using this manure. Until the fiscal restriction is removed, at any rate in favour of the cultivators, we cannot expect that the use of the nitrates as manure will become general in India.

The protection of the salt revenue, requiring as it does, that saltpetre refineries should be worked under restriction, probably enhances the cost of production of nitrate of potash, and makes its competition with nitrate of soda difficult so far as the manure trade is concerned. Notwithstanding the largely increased demand in Europe for nitrates as manures, the export trade in nitrate of potash is practically no larger now than it was twenty years ago (*O'Conor, Trade Review, 1888-89*). In 1888-89 the export trade in saltpetre amounted to 420,503 cwt., while in 1884-85 it was 451,917 cwt. Nearly one-third of this amount went to China, Hongkong, and the Straits Settlements, over one-third to the United Kingdom, while the remainder was distributed in small quantities to various other European countries and to the United States. The price of nitrate of potash, however, renders it impossible that it can compete as a manure with the crude nitrate of soda from South America, in spite of the greater manural value of the potash salt.

Chloride of Sodium. 256

(4) **Chloride of Sodium.**—In Europe chloride of sodium or common salt has at various times been employed as a manure, but its effects are variable and uncertain, so that its use has of late years rather diminished than increased. Its employment in conjunction with nitrate of soda and potash has already been alluded to. It is said to enable the plant to absorb more silica from the soil; but this view is not supported by any definite experiment. It is generally used as an auxiliary with lime or the nitrates. Heavy dressings of salt are sometimes applied to pasture land to improve the herbage and destroy insect pests. Salt is also used to prevent the too rapid decomposition of manures, a purpose for which in India it might be employed with benefit, as farmyard manure is so rapidly decomposed that in a few months it becomes a fine mould which, although very valuable, does not answer the purposes of the ordinary article.

The high price of salt in India is, however, a serious drawback to its use by the ordinary agriculturist, and although it has been employed on the experimental farms, yet we cannot hope to see its general introduction among the native farmers until some means of denaturalisation is discovered so as to render it unfit for human consumption; while it remains fit for use by cattle and as manure. Various experiments have been tried and a large reward offered by Government to attain this end, but as yet all the methods tried have been unsuccessful, pure salt being easily

Mineral Manures. (*W. R. Clark.*) MAOUTIA Puya.

MINERAL MANURES.

recovered from the preparations. The methods used in Germany for the denaturalisation of salt, where salt for manure is issued duty free mixed with charcoal dust, ashes, lamp-black or ordinary soot in different proportions, although effective there, would not be so in India, where the salt duty is much heavier, and cheaper means of restoration exist. (*Spons' Encycl.; Encycl. Brit.*)

Coprolite. 257

(5) **Coprolite.**—This name was originally applied by Dr. Buckland to substances found in many geological strata which he believed to be the dung of fossil animals. Its signification has, however, now been widened to include also other phosphatic concretions. Considerable interest has been aroused in agricultural circles in India of late years by the discovery of coprolite at Masúrí in the North-Western Provinces, and of fossil bones in the alluvium of the Jumna. If these contain, as was said on their discovery, more than 50 per cent. of tricalcic phosphate, and the supply is as abundant as is anticipated, the use of the superphosphate of lime as a manure in India may be hoped to become more general. With regard to the coprolites at Masúrí, some confusion was at first caused by apparently contradictory chemical analyses made by different authorities, but this was found to be due to the inequality of the fossiliferous strata, and it now appears indubitable that the greater part of the Masúrí rock is at any rate as valuable as the Cambridge coprolite strata. The desiderata of cheap carriage and a cheap supply of crude sulphuric acid to convert the tribasic into the soluble phosphate, at present alone curtail its use. Should these be met, there is no doubt that a considerable industry in this form of mineral manure would arise.

Ammoniacal Liquor. 258

(6) **Ammoniacal Liquor.**—The ammoniacal liquor of gas works is another good manure which ought to be utilised wherever available. Of course in India this is only so in the neighbourhood of a few large towns; but there it is specially applicable, as it is invaluable to the market gardener for the cultivation of vegetables.

Other Mineral Manures. 259

(7) **Other Mineral Manures.**—Various other mineral manures, such as the commercial ferrous sulphate, basic slag, the carbonates of soda and potash, have been used in Europe with good effect; but at present in India, they are either not available, or the cost at which they can be obtained precludes their use by the ordinary cultivator.

(*G. Watt.*)

MAOUTIA, *Wedd.; Gen. Pl., III., 391.*

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Maoutia Puya, *Wedd.; Fl. Br. Ind, V., 592;* URTICACEÆ.

Sometimes called WILD-HEMP by early writers and also PUA-HEMP.

Syn.—BŒHMERIA PUYA, *Hook.*; B. FRUTESCENS, *Don.* (not of *Thunb.*); URTICA PUYA, *Ham., in Wall. Cat.*

Vern.—*Póí, púa,* HIND.; *Yenki* (Limbu), BENG.; *Puya,* NEPAL; *Kyinki, kienki,* LEPCHA; *Púya,* KUMAON; *Sat sha yuet,* BURM.

References.—*Brandis, For. Fl., 436; Kurz, For. Fl. Burm., II., 429; Gamble, Man. Timb., 323; Atkinson, Him. Dist., 317, 798; Royle, Fib. Pl., 368; Kew Off. Guide to the Mus. of Ec. Bot., 124; Hannay, in Jour. Agri.-Hort. Soc., VII (Old Series), 223; Memoir of Dehra Doon, 21; Madden, in Journ. As. Soc. Beng, XVIII., I., 622; Indian Forester, XIV., 269, 273, 275; Watt, in Col. & Ind. Ex. 1886, Commercial Reports.*

Habitat.—A native of the Tropical Himálaya (ascending to 4,000 feet in altitude), distributed from Kumaon and Garhwál eastward to Nepál, Sikkim, the Khásia hills, and the Assam Valley and thence to Burma, the Straits Settlements, and Japan.

FIBRE. 261

Fibre.—Although many authors refer to this FIBRE and state that it closely resembles Rhea, and may be prepared and used in the same

FIBRE.

manner, yet no one seems to have performed independent experiments with the *pei* fibre, and the available information is, therefore, of an indefinite nature. Dr. Campbell's description of the fibre, published in Royle's *Fibrous Plants*, is the only complete account available up to date. The following extract will be found interesting :—

Description. 262

"*Description.*—The leaf is serrated, of a dark green colour above, silvery white below, not hairy or stinging; and has a reddish pedicle of about three inches long. The seed forms in small currant-like clusters along the top of the plant, and on alternate sides about an inch apart. Two small leaves spring from the stem at the centre of and above each cluster of seed.

"*Habitat.*—The *Pooah* is not cultivated but grows wild and abundantly in the valleys throughout the mountains of Eastern Nepál and Sikkim, at the foot of the hills skirting the Terai to the elevation of 1,000 to 2,000 feet, and within the mountains up to 3,000 feet. It is considered a hill plant, and not suited to the plains or found in them. It does not grow in the forests, but is chiefly found in open clear places, and in some situations overruns the abandoned fields of the hill people within the elevations which suit it. It sheds its leaves in the winter, throws them out in April and May, and flowers and seeds in August and September.

Cutting. 263

"*When Used.*—It is cut down for use when the seed is formed; this is the case with the common flax in Europe. At this time the bark is most easily removed and the produce is best. After the seed is ripe it is not fit for use, at least it is deteriorated.

Preparation 264

"*How Prepared.*—As soon as the plant is cut, the bark or skin is removed. This is very easily done. It is then dried in the sun for a few days; when quite dry, it is boiled with wood-ashes for four or five hours; twenty old, it is beaten with a mallet on a flat stone until it becomes rather when cold pulpy, and all nearly one-third of the bark was disappeared; then it is well washed in pure spring water and spread out to dry. After exposure for a day or two to a bright sun it is ready for use. When the finest description of fibre is wanted, the stuff, after being boiled and beaten, is daubed over with wet clay and spread out to dry. When thoroughly dry the clay is rubbed and beaten out; the fibre is then ready for spinning into thread, which is done with the common distaff.

Uses. 265

"*Uses.*—The *Pooah* is principally used for fishing nets, for which it is admirably adapted on account of its great strength of fibre and its extraordinary power of long resisting the effects of water. It is also used for making game-bags, twine and ropes. It is considered well adapted for making cloth, but is not much used in this way.

"Dr. Falconer recognised the *Pooah* as the Bœhmeria frutescens, *Don*, of Botanists, common at lower elevations on the Himálaya from Garhwál to the Sikkim hills (Ganges to Burrampooter). In the outer hills of Garhwál and Kumáon it is called *Poee*, and the tough fibre is used there for making nets. In Darjiling, B. frutescens goes by a similar name. *Pooah* and the fibre is used for similar purposes. It was first described by Thunberg, who distinguishes it from the textile species, Bœhmeria (Urtica) nivea, which grows there in abundance.

"Captain Thompson, to whom the specimens of the *Pooah* fibre were sent, says of it, that 'when properly dressed, it is quite equal to the best Europe flax, and will produce better sail-cloth than any other substance I have seen in India. I observe from Dr. Campbell's communication that mud is used in the preparation, which clogs it too much, &c. My Superintendent, Mr. W. Rownee, who understands the nature of these substances, tells me that if potash were used in the preparation (which is invariably done with Russian hemp and flax) instead of clay or mud, that the colour

Pua-fibre. (*G. Watt.*)

MAOUTIA Puya.

FIBRE.

would be improved, the substance rendered easy to dress, and not liable to so much waste in manufacturing'" (*Royle, Fibrous Plants, 368—370*).

The above quotation regarding **Maoutia Puya** and the incidental allusion to it in the remarks regarding Rhea have very nearly recorded all that has to be said. The large bale of the fibre, shown at the Colonial and Indian Exhibition, and which was obtained from Assam, was either, as **Messrs. Cross & Bevan** suspect, a badly-prepared sample or the fibre is quite worthless. The former explanation would be in accordance with all previous reports, for, although admittedly inferior to Rhea, it would be hard to believe that a fibre so popular with the fishermen could be so utterly worthless as **Messrs. Cross & Bevan's** analysis would make it out to be. The following demonstrates the results of their chemical examination of the fibre :—

Moisture	11·2
Ash	8·2
Hydrolysis for 1 hour in 1 p. c. Na_2O	62·7
Cellulose	32·7

According, therefore, to **Messrs. Cross & Bevan's** observations, **Maoutia Puya** would be the least worthy fibre in India, since it has the next to the lowest amount of cellulose and loses more of its weight under hydrolysis than any other fibre examined by them. In their remarks regarding the fibre, however, these distinguished chemists affirm : "A large bale of this fibre was shown at the Colonial and Indian Exhibition, and by experts pronounced identical with Rhea. It now remains to be carefully ascertained in India whether there would be any advantage in cultivating this plant in place of **Bœhmeria nivea**. We can only repeat what we have said elsewhere, that every effort should be put forth in India to ascertain the peculiarities of every plant allied to Rhea. In some respects the true Rhea is too strong, and a Rhea-like fibre, a little inferior in point of quality, that could be more easily cultivated and more cheaply separated from the twigs, would in all probability prove a more profitable and more acceptable fibre than Rhea, which has occupied, and justly occupied, the minds of experts for the last few years.

"The specimen of this fibre exhibited was very inferior in many respects. It is introduced here, as presumably its rightful place, when normally prepared.

"Not only was the specimen inferior in point of preparation, but it was found in the microscopic examination impossible to isolate the ultimate fibre, by reason of its breaking up under the needles. Many of the fibres of the URTICACEÆ show this tendency to brittleness; but with special attention to cultivation and the conditions of growth, these defects can in all probability be removed."

It is needless to add anything further except to emphasise what has already been said—namely, that if **Messrs. Cross & Bevan's** analysis be confirmed as representing the fibre, an effort should be made to replace its cultivation with the true Rhea or China-grass, or at all events to see that consignments of *Poi* are not sent to Europe under the name of Rhea.

The above compilation appeared in the publication edited by the writer—Selections from the Records of the Government of India (*Vol. I., Pt. II. (1888-89), 312-315*) ; it has since transpired that the bale of supposed *Poi* fibre examined by **Messrs. Cross, Bevan, & King** was in all probability not *Poi*. In connection with the preparation of the fibres for the Imperial Institute an authentic sample of that fibre has been secured. On this subject **Mr. Gammie** of Mungpoo, Dárjíling, furnishes the following information :—"The whole sample has been prepared by the method pursued by the Nepálese and Lepchas.

MARANTA arundinacea. West-Indian Arrow-root—

FIBRE.

"The bark is peeled off the stems in long strips; boiled in water thickened with common wood-ashes until it is pulpy; then as much as possible of the adhering bark is separated from the fibre by alternately beating with a wooden mallet and washing in cold water. After this the water is rinsed out, and each bundle of fibre is thickly covered with a paste of micaceous clay, and dried. When thoroughly dry, the clay and the remaining bark are easily shaken off, leaving the fibre in a state fit for use. If fibre is required free from dust, it is repeatedly rinsed until the water runs clear, and then re-dried.

"The white or bluish-white clay found here and there near streams is preferred, as it gives the fibre a good colour.

"This clay, by being fused with fire, is re converted into common micaceous, schistose stone.

"If the appearance of the fibre is of no consequence, yellow clay is said to be as effective.

"I do not know whether the action of the clay is altogether mechanical or not. A few samples which were prepared by treatment with lime and chalk were coarse in appearance and rough to the touch; those treated by clay, on the other hand, were soft and silky. Although the *Pooa* is rather a common plant, it is seldom gregarious to any extent as far as I know; so that the collection of a large quantity entails an expenditure which must exceed the value of the fibre extracted. I obtained five maunds of stems, by contract, for three rupees per maund, but I question if I could obtain them at the same rate again, as the people had to search far and wide for even that quantity. At a moderate estimate the further cost to manufacture the fibre was five rupees, making a total of twenty rupees.

"The fresh stripped bark weighed 63 lb and yielded only 4 lb of fibre. The cost of producing one pound of fibre would, therefore, be five rupees.

"*Pooa* is chiefly used for fishing nets and lines. I am told that formerly the Lepchas made cloth from it, but the contraction and expansion readily caused in it by atmospheric changes made it uncomfortable and undesirable for wearing apparel."

It would thus seem that little hope need be entertained of obtaining this fibre from the wild stock. Should it prove of value (when Mr. Gammie's sample has been submitted to commercial and scientific tests) and to possess advantages over that of Rhea the plant would have to be cultivated.

266 MARANTA, *Linn.; Gen. Pl., III., 649.*

A genus of SCITAMINEÆ (the Ginger Family) named in honour of Maranti, a Venetian botanist and physician of the sixteenth century. It gives its name to the Tribe MARANTEÆ and is characterised by having a terminal few-flowered but branched panicle, the flowers borne on slender ebracteate peduncles with narrow deciduous sheathing bracts at the origin of the ramifications. Corolla tube cylindrical, often globous: staminal tube contained within the corolla, petaloid with a solitary anther on one side. Ovary by abortion 1-celled and 1-seeded with two small empty cells. Fruit ovoid, somewhat oblique with a fleshy green pericarp. There are some ten species in the genus, all natives of America, with one or two widely cultivated in the Old World on account of the starch contained in their tubers.

267 **Maranta arundinacea**, *Linn.; Fl. Br. Ind., VI., 198;* SCITAMINEÆ.

WEST INDIAN ARROWROOT—A name given to distinguish it from East Indian, the produce of Curcuma angustifolia, *Roxb.*;—see Vol. II., 652-655. [*Ger.*

ARROW-ROOT, *Fr.*; AMERIKANISCHES STARKMEHL, ARROWMEHL,

Syn.—It seems probable that M. SAGITTIFOLIA, *Wall.*, and M. INDICA, *Tussac*, are synonyms for a cultivated form of M. ARUNDINACEA, *Linn.*, and are not specifically distinct, as some writers maintain.

Introduction of, into India. (*G. Watt.*) MARANTA arundinacea.

Vern.—*Tikhor (tickhur)*, HIND.; *Tavkil*, MAR.; *Ararut*, GUZ.; *Kúaka neshasteh*, DEC.; *Kuva mavú* or *kuamau*, TAM.; *Tavaksha*, KAN.; *Kúa, Kughei*, MALAY; *Pen-bwa*, BURM. It seems probable that all the vernacular names here given, strictly speaking, refer to the starch obtained from East Indian arrowroot—**Curcuma angustifolia**—though they are doubtless now-a-days given to any form of that farinaceous substance.

References.—*Roxb., Fl. Ind., Ed. C. B. C., 10; Voigt, Hort. Sub. Cal., 575; DC., Orig. Cult. Pl., 81; Mason, Burma and Its People, 507, 806; Lindley and Moore, Treasury of Bot., 720; Fluck. & Hanb., Pharmacog., 629; U. S. Dispens., 15th Ed., 1693; O'Shaughnessy, Beng. Dispens., 646, 647; Bent. & Trim., Med. Pl., 265; Smith, Ec. Dic., 25; Shortt, Manual of Indian Agric., 301; Atkinson, Him. Dist. (Vol. X., N.-W. P. Gaz.), 704; Simmonds, Tropical Agriculture, 347; Bombay, Man. Rev. Accts., 103; Gazetteers:—Mysore and Coorg, I., 70; Agri.-Hort. Soc. Ind.:—Trans., II., 79-81, 393, 418; Journal (Old Series), II., 215, 262, 266, 316, 365; III. (Proc.), 167, 243, 282; VIII. (Proc.), 24.*

FOOD. Root. 268

Habitat, History, & Food.—Authors are agreed that the name arrowroot was derived from the alleged alexipharmic properties of the plant. The juice of the fresh ROOT was employed by the Mexican Indians as an external application against the action of the poison used on their arrows. The earliest authentic mention of the plant occurs in **Sloane's** *Catalogue of Jamaica Plants* (1696), where it is called *Canna India radice alba alexipharmace.* It was first discovered in Dominica, thence sent to Barbadoes and, subsequently, to Jamaica. **Patrick Browne** (in 1756) mentions it as cultivated in gardens in Jamaica, and, in addition to alluding to its alexipharmic virtues, informs us that "the root washed, pounded fine, and bleached makes a fine FLOUR and STARCH," which was sometimes used as food when provisions were scarce. In 1750, **Hughes** (*Natural History of Barbadoes, 221*) spoke of the starch made from the roots as far excelling that of wheat.

Flour. 269 Starch. 270

According to some writers, arrowroot was introduced into England by **Houston** about 1732, but in **Renny's** *History of Jamaica* (232), 24 cases are said to have been the first consignment to England, and these were exported in 1799. Some confusion seems to have been made by writers both in Europe and India between the farina from this plant and the East Indian arrowroot, if not also with tapioca, the Brazilian arrowroot. There appears to be no doubt of the fact that all forms of the arrowroot plant were derived originally from America. The so-called arrowroot of India, referred to by **Bentley & Trimen** and others under the name of **Maranta indica**, a species which had narrower, sharper, and smoother leaves than the ordinary plant, was either **Curcuma angustifolia** or one of the earliest introduced forms of **Maranta**, which came to India before the first record of introduction. That the true arrowroot plant must have been introduced about the beginning of this century, there seems no doubt, but in Bengal at least it did not attract attention much before 1830. The earliest mention of a plant belonging to the genus **Maranta** is curiously enough associated with Sylhet. Thus **Wallich**, in 1833, recognised the plant, which the *Agri.-Horticultural Society of India* had been cultivating under the impression that it was the true arrowroot, as being "**Maranta ramosissima** introduced into the Botanic Gardens from Sylhet about twelve years ago." This, he said, was quite "different from the West India **M. arundinacea.**" The Sylhet plant was probably the **M. indica** of some writers, but, as remarked above, the more recent authors confused that with **Curcuma angustifolia**, the arrowroot plant of Southern and Western India. We have thus no record of the introduction of **M. ramosissima** into Sylhet, nor for that matter into India, nor indeed have we any distinct record for **M. arundinacea**, but that they are both American plants there seems no doubt. If any form of **Maranta** be a native of India, the singular silence of **Roxburgh** (for he alluded to

MARANTA arundinacea. West-Indian Arrow-root—

HABITAT, HISTORY & FOOD.

arrowroot as an American plant only which yielded a similar farinaceous substance to that obtained from **Curcuma angustifolia**) would be difficult to get over; indeed his silence practically proves that, in his time at least, the true arrowroot plant had not been even introduced. In the XIth Volume (1810) of the *Asiatick Researches*, for example, **Roxburgh** says: "I shall only add, on the subject of this nutritious powder, that it is very similar to the powder which is obtained in America from the roots of **Maranta arundinacea**, and which is known in Europe by the name of Indian arrow-root." **Ainslie**, who wrote some time after **Roxburgh** (1823), says that "**Maranta arundinacea** has lately been brought to Ceylon from the West Indies, and thrives well at the *Three Korles*, where arrowroot is now prepared from it and reckoned of the finest quality." It is remarkable that **Wallich**, if he meant that **M. ramosissima** was a native of Cachar, should not have said so, since he must have known that that opinion was opposed to **Roxburgh** and **Ainslie**. **Voigt** (*Hort. Suburb., Cal.*, 575) speaks of it in 1845 as cultivated in the West and East Indies; he adds, that it flowers in the rainy season, from which fact it may be inferred that it was, at the time he wrote, regularly cultivated in India. **Firminger**, who in 1863 brought out the first edition of his *Manual of Gardening in India*, while comparing the arrowroot of **Curcuma angustifolia** with the true article, says: "I cannot tell why any but the genuine kind should be produced at all in this country, or whether any difficulty is experienced in the cultivation of **M. arundinacea** on the Madras side; in Bengal the plant may be obtained in any abundance, and cultivated with the greatest ease. **Dr. Jameson** states too, that it thrives in the Saharanpur district and throughout the North-West Provinces."

The earliest direct mention of the introduction of Maranta to India is the passage to which reference has been made. The *Agri.-Horticultural Society of India* obtained roots from the Cape of Good Hope. These were cultivated and gave a net profit of R2,307-10 from 3 *bighas* of land, planted in 1831. A demand for roots thus arose, and the Society distributed all they had and were prevented from indenting for a further supply from the Cape by **Dr. Wallich's** report, that the plant could be had in Sylhet. No mention is made of the true West Indian stock having been procured, but doubtless it is grown in India now, though it seems probable, from the facts here mentioned, that the form known as **M. ramosissima** must have been widely distributed, and is thus probably cultivated by many persons who are ignorant of its not being the best West Indian arrowroot. The available information on this subject is, however, so imperfect that little more can be done than to indicate, as already done, our imperfect knowledge.

CULTIVATION. Bengal 271

METHOD OF CULTIVATION AND PREPARATION OF THE FARINA.

1st, Bengal.—The account given by **Firminger** may, perhaps, be accepted as the best statement, although, of course, he says nothing as to the extent of its cultivation, and his description is of a general nature, hence more or less applicable to all India:—"The root," he writes, "should be put in the ground in the month of May. Drills should be made about three or four inches deep and two feet apart, in which the roots should be laid at the distance of a foot and a half from one another, and the earth covered over them. As the plants grow, they should be earthed up in the same manner that potatoes are. They love a good rich soil, and plenty of water during the time of their growth, which latter, indeed, they get naturally, as their growing time is during the rains. They bear their small white flowers about August, and in January or February the crop may be taken up for use. A month or two previous, however, water should be entirely withholden, to

allow the roots to ripen. They are of a pure ivory-white colour, and should be as large as moderate-sized carrots. The smaller ones should be reserved for a fresh planting, and the pointed ends also of the larger ones, at the extremities of which the eyes are situated, should be broken off, three inches in length, and kept for the same purpose. CULTIVATION. Bengal.

"The mode of preparing the arrowroot is very simple. The roots after being well washed should be pounded to a pulp in a wooden mortar, which may be hired for the occasion from the bazár. The pulp should be thrown into a large vessel of water, which will become turbid and milky, a portion of the pulp remaining suspended in it as a fibrous mass. The fibrous part should be lifted up, rinsed, pounded again in the mortar, thrown again into the water, lifted up a second time, rinsed, and then thrown away. The milky-looking water should be then strained through a coarse cloth into another vessel, and when the sediment has settled, the water should be poured gently off and clean fresh water poured upon the sediment. This, after having been well stirred up, should be strained through a fine cloth, and on settling the water should again be carefully and gently drained away. The sediment, which is then fine pure arrowroot, should be dried on sheets of paper by exposure to the sun."

In the *Journals of the Agri-Horticultural Society of India* frequent mention is made of Chutia Nagpur arrowroot. Thus, Dr. Mouat reports on a sample prepared in 1843 at Purulia. In the same year Babu Sumbu Chunder Ghose forwarded to the Society twelve canisters of arrowroot grown and manufactured at Bírbhúm. The report on these samples was to the effect, that the farina was of excellent quality, well prepared and dried, without any disagreeable odour or flavour. "It forms a good jelly, and is well adapted for all the purposes to which this mild and nutritious substance is applied."

At the Colonial and Indian Exhibition excellent samples of arrowroot prepared and tinned in the European method, were shown by Mr. H. H. Abdoollah of Colootolla near Calcutta. It is known that several other makers produce arrowroot which successfully competes, both in quality and price, with the imported powder, but definite particulars as to the extent of cultivation are not available.

2nd, North-Western Provinces and Oudh.—Atkinson writes: "This root has been successfully cultivated in these provinces. The tubers are ready for digging in January, and should be scraped and well washed before being powdered, in order to remove the acrid poisonous juice. An ordinary piece of tin punched with holes makes a good grater. After being washed the powder should be dried in the sun before being stored. The arrowroot produced from these tubers at Haldwani, near Naini Tál, by Mr. Fraser has been pronounced by experts both here and in Europe to be equal to the best West Indian arrowroot." In a report of the *Lucknow Horticultural Society, 1843*, mention is made of the despatch to Calcutta of a sample of arrowroot made from the plants grown in the gardens. N.-W. P & Oudh. 272

3rd, Madras.—The extent to which the true arrowroot is cultivated in South India cannot be discovered. Many writers allude to arrowroot, however, and speak of it as an important crop, but very probably the chief article of trade is the East Indian form Curcuma angustifolia. It is significant, however, that Sir Walter Elliot (*Fl. Andh.*, 142) should state that M. ramosissima, *Wall.*, the *Pála ganda* of the Telegu people is "wild in all the hill forests." That name, according to Moodeen Sheriff, would appear to denote rather Alpinia Galanga, and Sir Walter does not refer to Curcuma angustifolia, although, while dealing with Curcuma sp. (the *Nakka pasupu*), he remarks that it is "wild Turmeric, C. montana vel angustifolia?" It seems thus probable that he made the mistake, by no means infrequent Madras. 273

CULTIVATION. Madras.

about the time he wrote (1859) of regarding the wild arrowroot of India as M. ramosissima. Shortt, in an essay on arrowroot cultivation in Madras, gives a somewhat incoherent account of the difference between Maranta and Curcuma. He, however, furnishes certain facts which must be accepted as applicable to both forms since he does not say of which he is dealing. Although the writer is therefore unable to give any information as to the relative extent to which these plants are cultivated, Shortt's essay may be here quoted:—"Arrowroot is largely grown in Travancore,* in Malabar and other districts of Southern India. The farina is manufactured in a rough and rude way; attention is not given to the cultivation of the plant, so as to increase the quantity and quality of starch. The mode of culture followed by the native producer is to roughly plough up sufficient land, level it, and plant out the rhizome or root stalks, at about one foot apart either way, before the commencement of the rains. Thereafter little or no attention is given to the crop. As a rule, manure is seldom used and the plants are not irrigated, except, perhaps, in exceptional instances, whilst crop after crop is taken off the same soil.

"For the proper and scientific culture of arrowroot, care should be taken in the selection of the soil. The crop grows best in a soft, loose sandy soil, or a somewhat porous loamy one, which admits of the rhizomes forming readily and enlarging to their fullest extent. The land should be well ploughed and freely manured with rotten farm-yard manure, which should be thoroughly mixed with the soil. It should then be levelled and formed into beds of a convenient size, so as to admit of the plants being irrigated when necessary, and the plants should be planted out 2 feet apart either way. On these hills† we prefer to place out the seed stalk in lines, 2 or 2½ feet apart either way, and when the plants have attained a height of 6 to 8 inches, to dig a trench, one foot wide, between every two lines, about half a foot deep; the soil thus obtained is used to ridge up the line of plants. This plan will also prove useful if it become necessary to irrigate the plants, which can be done by the trench between the lines, if care is taken to keep the ridges along the lines of plants well earthed up at all times. The plants should have plenty of room to enable them to form large clusters.

"For seed we generally prefer the root-stalks with their fibrous roots broken up, and the stalks cut short to about four inches in length. The first inch or two of the rhizomes will also answer the purpose of seed, in fact any portion of the rhizome of the size of an inch, containing a joint, will answer the purpose equally well. The rhizomes are fit to be taken up in about nine or ten months. They are planted out in the month of March and taken up in the following January or February. After the plants are put out, they are hand-watered twice a week, till they become established, but, where facilities exist, other modes of irrigation may be resorted to; and about once a month the field should be weeded, the earth loosened freely around the plants, and the stalks kept well earthed up."

Dr. Shortt furnishes an estimate of the expense of cultivation which amounts to R50 per acre. He then adds:—"The average crop of rhizomes produced on an acre of land is 2,500 pounds, yielding 400 pounds of farina, the average is one-fourth the quantity of the cormus, but for safety I have fixed it at one-sixth the quantity which at four annas the pound will realize R100; the retail price of arrowroot is from 12 annas to R1 the pound, and according to my estimate, deducting R50 for cost of cultivation, there is a balance of R50 as the net profit. With care and attention in the cultivation and preparation of the arrowroot, the profit will be found to exceed the estimate greatly."

* Cont. with Manihot, pp. 160 & 161. † 4 Shevaroys.

West-Indian Arrow-root. (*G. Watt.*) | MARBLE.

CULTIVATION.

Dr. Shortt's description of the process of manufacture does not materially differ from that given above by Firminger, and it need not, therefore, be reproduced here.

Bombay. 274

4th, Bombay.—Graham (*Cat. Bomb. Pl., 212*) alludes to Maranta ramosissima, *Wall.* (*Pl. As. Rar. 3 t., 286*) as a native of Sylhet which had been introduced into Bombay by Mr. Nimmo, from Bengal. "It has numerous long clavate tubers, and much resembles the West India arrowroot" (*Wall.*). The dry air, says Graham (quoting Gibson), of the Deccan in the cold season seems to affect its development. Dalzell & Gibson in their *Bombay Flora* repeat the same statements under the two names, M. Zebrina and M. ramosissima, two plants which Graham, and correctly so, kept distinct. In Dr. W. Gray's sketch of the botany of Bombay the remark occurs, "M. arundinacea, the West Indian arrowroot, exists in a few gardens, and, judging from its luxuriant growth, is capable of being profitably cultivated in Bombay."

Burma. 275

5th, Burma.—Mason says: "The true arrowroot plant was introduced several years ago by Mr. O'Riley, and is beginning to be largely cultivated. The arrowroot made is not inferior in quality to any imported; while it is sold for half the price, at a good profit. A gentleman at Tavoy has sold a considerable quantity for exportation this year, and has orders for more than a thousand pounds of the next crop" (*Burma and Its People, 507*). Mention is made of Mr. O'Riley's introduction of the root into Burma in the *Proceedings of the Agri-Horticultural Society of India* (*1844*). He there states that he had been so successful with the few bulbs of Maranta arundinacea furnished to him by the Society that he intended to extend its cultivation considerably. Mr. O'Riley adds that, without exception, the persons to whom he had given tubers had pronounced it superior to Speed's, and that as the gardens of the natives possess a fine free soil of the richest description, he considers its introduction into Tenasserim Province of some importance. In the same year Major D. Williams sent to the Society samples of a bulb and farina prepared from it which he considered far superior to arrowroot. He then remarked "the arrowroot plant grows all over Arracan and is eaten as a vegetable." From this it would be difficult to know what either of the two plants alluded to may have been, but very probably neither of them were Maranta. In a later communication, however, Major Williams furnishes fuller details from which it would appear that Dr. Wallich determined his bulb that yielded a far superior arrowroot to the true plant to be Tacca pinnatifida. But the Arracan arrowroot, which was eaten as a vegetable, does not appear to have been determined. Could it have been the sweet cassava which in Assam, about the same time as the above appeared, was also stated to be plentiful and to be eaten as a vegetable?

Maranta dichotoma, *Wall.*, see **Phrynium dichotomum,** *Roxb.*; Vol. VI.

MARBLE, *Ball, in Man. Geol. of Ind., III, 455—471, 686.* 276

The term marble is geologically restricted to limestone or carbonate of lime capable of receiving a polish. It occurs in several different forms, two of which are unicoloured, *viz.*, white and black, while many varieties are streaked and parti-coloured. The veining or colouring is derived from the presence of accidental minerals, frequently metallic oxides, also in many cases from imbedded fossil shells, corals and other organisms.

Marble, *Mallet, Geol. of Ind., IV.* (*Mineralogy*), *150.* 277

MARBRE *Fr.*; MARMOR, *Ger.*; MARMO, *Ital.*

Vern.—*Safaid-pattar, Kalai-ka-pattar, Shah-neaksadi,* HIND. & PB.; *Pulalani, marmar,* MALAY.; *Sung-i-marmar,* PERS.

MARBLE.

The subject of the occurrence of MARBLE in India has already been discussed, together with that of LIMESTONE, in the article CARBONATE OF LIME, Vol. II., 143—152. For more detailed information the reader is referred to *Ball, in Man. Geology of India, l. c.*, in which the subject has been very fully and elaborately discussed.

The following note has been kindly furnished by Mr. Medlicott on the extent to which marble is worked in India:—

Jabalpur. 278 Himalayn. 279 Rajputana. 280

"Marble of inferior quality is found in the metamorphic rocks of the Peninsula and the Himálaya, but the only place where it is worked is in Rájputána, where the marbles of *Jaipur* and *Jodhpur* are celebrated over the whole of India. The marble rocks at Jabalpur also yield marble (a dolomite) of good quality, a block sent to the Paris Exhibition having been declared to be equal to Italian marble for statuary purposes; as a rule, the beds are much jointed and crushed, so that it would be difficult to obtain large blocks in any quantity."

Mr. F. R. Mallet in his *Mineralogy* gives the following analyses of three well-known Indian dolomites:—

	I.	II.	III.
Calcium carbonate	55·48	50·7	60·5
Magnesium carbonate	43·55	37·8	38·7
Ferrous carbonate	·36	...	...
Oxide of iron and alumina	...	1·0	·3
Insoluble	·61	·8	
	100	91·3	99·5

I. The white saccharine marble of the Jabalpur rocks referred to above as equal to Italian stone for statuary purposes.

II. Light grey saccharoid, and III., white, almost crypto-crystalline marble from the Titi river, Western Duars.

To the addition to the Rájputána marbles referred to by Mr. Medlicott, ...lf a fourexist of the stone being worked, to a small extent, in other parts of ...sts. Thus, Thus, it is stated that the shell-marble of Kerudamangalam ...nts, wo table-tops, paper weights, and small ornaments in Trichinopoly. ...records ...ceive when polished, is of a dark grey colour, and is marked like the ...the countrypolar "Purbeck" stone with white sections of included shells (*Man. ...is made int... Dist.*, 69).

Kerudamangalam. 281 White. 282 Black. 283 Yellow. 284 Grey. 285 Veined. 286

This marble ... general ... root-stalks with their fibrous roots ... well-known "... the stalks cut short to a... of *Trichinopoly* the rhizomes will ... a yellow marble called *Shahmaksadi* ob-

Mr. Baden Powell ... that ... tained from Manairi, Yusufzai, is cut into charms and ornaments in the Peshawar district (*Pb. Prod.*, 37). He also mentions white, black and grey marble from Delhi; an inferior marble, *Kalai-ka-pattar*, from Karnaal in Hissar; grey marble from Bhunsi in Gurgáon; black marble from Kashmír; and a form of translucent marble, *safaid-pattar* from Sháhpúr. Most of these marbles, however, are used like limestone for making fine qualities of *chunam*. A veined marble (*tabri*) found in the Kowagarh hills of Ráwalpindí is occasionally worked into cups and ornamental objects, but the cost is great on account of the hardness of the stone and the absence of skilled labour. The pillars of the pavilion in the garden of Bairam Khán at Attock are made of this beautiful stone (*Rawalpindi Gaz.*, 11). An inferior form of marble is frequent in the Sutlej Valley which does not appear to have been worked. The beautiful semi-transparent white marble obtained from the Toygun hills in Upper Burma is extensively used for carving the well-known sitting and recumbent figures of Gaudma, to be found in the pagodas, &c., of many parts of that country.

Sutlej. 287 Burma. 288

Margosa tree, see Melia Azadirachta, *Linn.*; MELIACEÆ; p. 211.

Marigold, see Calendula officinalis, *Linn.*; COMPOSITÆ; Vol. II., 24.

Marlea. (*G. Watt.*) MARRUBIUM vulgare.

[SITÆ; Vol. VI., Pt. II.

Marigold, African—the *genda* of India, see Tagetes erecta, ; COMPO- [*Ind. III., 309.*

Marigold Burr, see Bidens tripartita, *Linn.*; COMPOSITÆ; *Fl. Br.*

Marigold, French, see Tagetes patula, COMPOSITÆ; Vol. VI., Pt. II. [II., 50.

Marigold, Marsh, see Caltha palustris, *Linn.*; RANUNCULACEÆ; Vol.

Marjoram, see Origanum vulgare, *Linn.*; LABIATÆ.

Marking Nut Tree, see Semecarpus Anacardium, *Linn.*; ANACAR- [DIACEÆ; Vol. VI., Pt. I.

MARLEA, *Roxb.; Gen. Pl., I., 949.* [CORNACEÆ. 289

Marlea begoniæfolia (begonifolia), *Roxb.; Fl. Br. Ind., II., 743;*

Syn.—M. AFFINIS, *Dcne.;* M. TOMENTOSA, *Endl. ex Hassk.;* DIACICARPIUM TOMENTOSUM, *Blume;* D. ROTUNDIFOLIUM, *Hassk.;* STYLIDIUM CHINENSE, *Lour.;* STYRAX JAVANICUM, *Blume.*

Var.—alpina, *H.f. & T.*, found in Sikkim at altitudes of from 6,000 feet to 9,000 feet.

Vern.—*Marlea, marliga,* (SYLHET), ASSAM; *Timil,* NEPAL; *Palet,* LEPCHA; *Garkum, budhal, túmbri,* N.-W. P.; *Tumri,* KUMAON; *Siálú,* (WARDWAN); *Prot,* KASHMIR; *Mandrá, bodará* (BIAS); *Siálú,* (CHENAB); *Tilpattra, chit pattra, Kúrkní,* (HELUM); *Padlú* (RAVI); *Budánár, memoká,* (KANGRA) PB.; *Tapuya,* BURM.

References.—*Roxb., Fl. Ind., Ed. C.B.C., 326; Brandis, For. Fl., 251; Kurz, For. Fl. Burm., I., 544, 545; Gamble, Man. Timb., 211; Stewart, Pb. Pl., 93; Miq. Fl. Ind. Bat., I, pt. I., 744; Baden Powell, Pb. Pr., 585; Atkinson, Him. Dist., 311; Indian Forester, XIII., 57.*

Habitat.—A tree (often small, but sometimes attaining a height of first feet), found throughout Northern India, at altitudes from 1,000 feet to from feet; common from the Panjáb to Bengal and Burma. Distribute Ple China and Japan. The variety alpina is met with in Sikkim where it ascends to 9,000 feet.

Fodder.—The LEAVES are sometimes given as fodder to cattle and goats. (*Stewart*) (*Conf. with Vol. III., 430*). FODDER. Leaves. 290

Structure of the Wood.—Wood white, soft, even-grained. Weight 42lb per cubic foot (*Gamble*). TIMBER. 291

Domestic Uses.—"The WOOD is used for houses in Sylhet" (*Roxb.*). DOMESTIC. Wood. 292

Marmelos, see Ægle Marmelos, *Corr.*; RUTACEÆ; Vol. I., 117.

Marmots, see "Rats, Mice, Marmots"; Vol. VI., Pt. I.

Marron, the French for Castanea vulgaris, *Lam.*, which see, Vol. II., 227.

Marron d'eau, the French for Trapa bispinosa, *Roxb.*; Vol. VI., Pt. II.

Marrow, Vegetable, see Cucurbita Pepo, *DC.*; CUCURBITACEÆ, Vol. [II., 641.

MARRUBIUM, *Linn.; Gen. Pl., II., 1206.*

Marrubium Malcomii, *Dalz.*, see Micromeria capitellata, *Benth.*;

M. vulgare, *Linn.; Fl. Br. Ind., IV., 671.* [p. 244; LABIATÆ. 293

Habitat.—This plant occurs in the Western Temperate Himálaya: Kashmír between 5 and 8,000 feet. Stewart and one or two other authors allude to this plant, but apparently its medicinal properties are not known to the people of India.

Medicine.—In Europe it enjoyed the reputation of possessing bitter tonic properties for which it was useful in many complaints. It still holds a MEDICINE. Plant. 294

MEDICINE. place in the American Pharmacopœia where it is described as laxative in large doses; is given to increase the secretion from the skin and occasionally from the kidneys. It was formerly regarded as deobstruent, and was recommended in chronic hepatitis, jaundice, amenorrhœa, phthisis, and various other chronic affections. By its mild tonic properties it may exercise a beneficial influence, but it has no specific property, and hence it is now mainly used as a domestic medicine (*U. S. Dispens., 15th Ed., 926*).

MARSDENIA, *R. Br.; Gen. Pl., II., 772.*

295 **Marsdenia Roylei**, *Wight; Fl. Br. Ind., IV., 35;* ASCLEPIADEÆ.

Vern.—*Murkúla* (Himálayan Districts), HIND.; *Murkila*, KUMAON; *Pather* (Chenab); *Tar, veri* (Salt Range), *Kurang* (Simla), PB.

References.—*Brandis, For. Fl., 333; Gamble, Man. Timb., 266; Stewart, Pb. Pl., 145; Wight, Contr. Bot. Ind., 40; Atkinson, Him. Dist., 313, 794; Royle, Fibrous Pl. Ind., 305; Journ. Agri.-Horti. Soc. Ind., XIV., 22; (New Series) I., 94.*

Habitat.—A large, twining shrub, of the Eastern and Western Himálaya. At Simla it ascends to altitudes close on 7,000 feet, but is most plentiful at about 3,000 to 5,000 feet. In Sikkim it is mentioned as met with at 4,000 feet. It may, therefore, be described as a warm temperate plant.

GUM. Caoutchouc. Gum.—The milky sap contains CAOUTCHOUC, but in so small quantity as to be of no value.

296 FIBRE. 297 Fibre.—It yields a FIBRE, of which fishing nets and strong ropes are manufactured. This has not, however, been scientifically examined, so that no opinion can be passed as to its relative value to the fibre of the next species. Royle mentions, however, that a sample of this fibre was sent to the great Exhibition of 1851 from Nepal. The plant might be extensively cultivated and probably more easily than that of M. tenacissima, as it is a free growing semi-succulent plant from which the fibre could probably be more readily separated than would be the case with the more tropical species. Mr. W. Coldstream, the Deputy Commissioner of Simla, saw an exceptionally large fish being hauled in from a stream in that district, the line being of so fine a quality as to excite his astonishment. He was shown the plant from which it had been prepared, and judging from Mr. Coldstream's description it was very probably the species here dealt with. The writer is not at any rate aware of any other Himálayan plant that would yield a fibre of the strength requisite for fishing lines.

[illegible]aman- records [illegible]

MEDICINE. Fruit. Medicine.—The unripe FRUIT is powdered and given as a cooling medicine (*Stewart*).

298 299 **M. tenacissima**, *Wight & Arn.; Fl. Br. Ind., IV., 35; Wight, Ic.,* RÁJMAHÁL HEMP. [*t. 590.*

Syn.—ASCLEPIAS TENACISSIMA, *Roxb.*; A. TOMENTOSA and A. ECHINATA, *Herb. Madr.*; GYMNEMA TENACISSIMA, *Spreng.*

Vern.—*Tongus*, HIND.; *Jiti* (Rájmahál Hills), *chiti* (PALAMOW), BENG.; *Babal Jati*, CENTRAL INDIA; *Haba*, (?) BOMB.; *Jiti, chiti*, TAM.; *Murudsálal*, SING.

References.—*Roxb., Fl. Ind., Ed. C.B.C., 256; Voigt, Hort. Sub. Cal., 537; Brandis, For. Fl., 333; Kurz, For. Fl. Burm., II., 201; Gamble, Man. Timb., 265; Trimen, Cat. Ceylon Pl., 55; Wight, Contr. Bot. Ind., 41; Atkinson, Him. Dist., 794; Royle, Fib. Pl., 303; Christy, Com. Pl. and Drugs, VI., 11, 37; Liotard, Paper-making Mat., 5, 47; Balfour, Cyclop., Vol. II., 856; Smith, Dic., 221; Kew Off. Guide to the Mus. of Ec. Bot., 97; Jour. As. Soc. P., II. (1867), 82; 1885, VII. (New Series) Proc., lxxi.; Gazetteers:—Mysore and Coorg, I., 56; N.-W. P., I., 82; IV., lxxiv.; Indian Forester, IX., 274; X., 195; XI., 302; XIV., 273; Journ. Agri.-Horti. Soc. Ind. (Old Series), III., 221-225; IX., 151; Pro., 128; (New Series) IV., Pro. (1873), 52; VII., Pro., 71.*

Jetí Fibre. (*G. Watt.*) **MARSDENIA tenacissima**

Royle calls this the Jetee Fibre. It is remarkable that a plant which yields so valuable a fibre and a caoutchouc should, practically, be unknown to the people of India. Indeed, by following the usual line of reasoning, based on vernacular names, the plant might be viewed as doubtfully a native of India, whereas it is nowhere cultivated, exists only in a wild state, and is, therefore, undoubtedly a native of this country.

Habitat.—A climbing plant, distributed throughout the lower Himálaya (ascending to 5,000 feet) from Kumáon to Assam and Burma: also found on the lower hills of Bengal—Rajmahal, Chittagong, &c. The plant is fond of dry barren localities, twining on the bushes and small trees. It might be extensively cultivated.

Gum.—A milky juice exudes from cuts on the stem, which thickens into an elastic substance, or CAOUTCHOUC which acts in the same way as India rubber in removing black lead marks (*Roxburgh*). GUM. Caoutchouc 300

Fibre.—Very little more can be said regarding this FIBRE than has already appeared in the volume of Selections from the Records of the Government of India published by the Editor of this work. In *Spons' Encyclopædia* (p. 982) it is stated: "The bark of the stems yields a valuable fibre, which is extracted by cutting the stems into sections, splitting them, drying them, steeping them in water for about an hour, and scraping them clean with the nails or with a stick. The hillmen simply dry the stems and altogether dispense with retting. About 6lb of clean fibre is a good day's work. The fibres are fine and silky, and of great strength, a line made of them breaking at 248lb dry and 343lb wet, as against hemp at 158 and 190lb. It is used locally for bow-strings and for netting." According to Roxburgh the plant was discovered in 1800. "During the rains," he says, "the natives of Rájmahál cut the shoots into lengths at the insertion of the leaves, peel off the bark, and with their nails, or a bit of stick on a board, remove the pulpy part." FIBRE. 301

The figures given above in Spons' account of the fibre are those first published by Roxburgh, and the facts appear to have been compiled from Royle's acccount of the fibre (*Fibrous Plants of India, 304*). Royle justly adds that "the plant is suited for better purposes than rope-making, besides not being eligible for this purpose, from its comparative rarity and mode of preparation. Mr. Taylor remarks that it might, however, be easily cultivated (*Jour. Agri.-Hort. Soc., 1844, V., 221*). One of the chief features of this fibre is its great elasticity, since it is, according to Royle, the second best of all the fibres in India.

Only a very small amount of it was shown at the Colonial and Indian Exhibition, but the sample was universally admired. Some of the experts indeed viewed it as a very superior quality of Rhea. According to Messrs. Cross, Bevan & King's chemico-microscopic examination of the fibre, it is very considerably superior to Rhea. The following table exhibits the results obtained by these chemists:—

	Moisture.	Ash.	Hydrolysis. (a) (Five mints.)	Hydrolysis. (b) (One hour).	Cellulose.	Mercerising.	Nitration.	Acid Purification.	Carbon percentage.
Marsdenia tenacissima	4·5	1·5	6·2	10·1	6·2	4·6	131·0	0·8	44·6
Bœhmeria nivea (Rhea)	9·0	2·9	13·0	24·0	80·3	11·0	125·0	6·5	...
Linum (Flax, European)	9·3	1·6	14·6	22·2	81·9	8·4	123·0	4·5	43·0
Calotropis gigantea .	7·3	2·5	13·0	17·6	76·5	...	153·5	8·5	44·0
Crotalaria (Sun-hemp).	8·5	1·4	8·3	11·6	83·0	11·3	150·5	2·7	44·3

FIBRE.

To allow of comparison four other fibres have been shown alongside of Marsdenia (the Rájmahál-Bowstring). That fibre heads the list in percentage of cellulose and loses considerably less than any of the others, either under hydrolysis with caustic soda or in the acid purification, while it holds the third place in increased weight by nitration. These are facts the value of which cannot be over-estimated. They point the fibre out as being, from a scientific stand-point, far more worthy of experimental cultivation than Rhea or any of the other fibres with which in the above table it has been compared. The one point of uncertainty regarding it, which practical experiments alone can solve, is its yield of fibre per acre as compared to the cost of cultivation,—in other words, the price at which it could be put down in the textile markets. The ultimate fibres are 5 to 20 mm. in length, *e.g.*, nearly as long as those of flax, and two or three times as long as those of sunn-hemp or of jute, though of course very much shorter than the fibres of Rhea. But from this point of view Rhea stands by itself, as its ultimate fibres (40 to 200 mm.) are far in excess of any other known fibre. Messrs. Cross, Bevan & King say of Marsdenia, "Next to Rhea it must rank in point of fineness and durability, and we cannot urge its claims to the attention of Government in too strong terms. If it can be shown that the fibre could be cultivated at all, it might then become a question whether the *kaba* or Rhea could be produced the cheaper."

It seems probable that to arrive at good results the long young twigs of the plant had better be treated by some chemical decorticating process, such as that of Favier, instead of being cut into short lengths and decorticated mechanically. The shortness of the fibre-ribbons, as usually met with, would presumably be viewed as unfavourable, but since this is by no means a necessity it might be well to adopt some process of decortication that would produce ribbons the full length of the twigs.

The plant is too scarce and unimportant-looking for its merits to come by the usual "private enterprise" means to be recognised by the manufacturer. It must be cultivated, and that too perhaps for a good many years, before a final opinion can be pronounced. It is a climber and does not appear to grow either rapidly or profusely, but there is no knowing what it might do under careful management. Very likely the allied species M. Roylei might, as suggested above, be found a more suitable species for experimental cultivation, but of course in warm temperate regions only, such as Kúlu, Simla, Kumáon, Kashmír, the Nilghiris, &c. It might indeed be even possible to grow it in the warmer parts of Europe. Marsdenia is, however, too valuable a fibre to be longer ignored, and it would serve a public good were the various Botanic Gardens and Agri.-Horticultural Societies to take its experimental cultivation under their special charge. Were the cultivation of M. tenaciassima to prove remunerative, the plant might be reared in every hedgerow of India, but, being a climber, difficulties exist with which the Indian cultivator of fibre crops has not as yet attempted to deal. In order to avoid these difficulties—the expense and trouble of constructing supports for a climbing plant—it would be a good step to ascertain whether it could be induced to crawl over the ground instead of requiring support. Although, as stated, it might be grown in every hedgerow over the entire length and breadth of the plains of India, success could alone be ensured by the production of a stock that might be planted in the usual way over a limited area.

302 **Marsdenia tinctoria**, *Br.*; *Fl. Br. Ind.*, *IV.*, *34*; *Wight, Ic.*, *t.* 5°0.

Syn.—MARSDENIA MONOSTACHYA, *Wall.*; ASCLEPIAS TINCTORIA, *Roxb.*; PERGULARIA TINCTORIA, *Sprengl.*; P. PARVIFLORA, *Blume.*; CYNANCHUM TINCTORIUM, *Heyne, Herb.*

An Indigo Substitute. (*G. Watt.*) MARSDENIA tinctoria.

Vern.—*Riyong,* (TEESTA VALLEY). BENG.; *Kali lara,* NEPAL; *Ryom,* LEPCHA; *Mai-nwai, mai-dee,* BURM.; *Turûm-akkar,* SUMATRA.

References.—*Roxb., Fl. Ind., Ed. C. B. C., 225; Voigt, Hort. Sub. Cal., 537; Brandis, For. Fl., 332; Kurz, For. Fl. Burm., II., 201; Gamble, Man. Timb., 265; Wight, Contrib. Bot. Ind., 40; Grah., Cat. Bomb. Pl., 119; Mason, Burma & Its People, 510, 801; McCann, Dyes and Tans, Beng., 126; Liotard, Dyes, 109; Balfour, Cyclop., Vol. II., 886; Indian Forester, XI., 326; XII., App., 17; Gazetteers:—N.-W. Provs., I., 82; IV., lxxiv.; Agri.-Hort. Soc. Ind. Trans., VIII., 89; Jour., III., 231, 232; VI., 50, 51, 142, 143; X., 293-294.*

Habitat.—A tall, climbing shrub, of the North-Eastern Himálaya and Burma; occasionally cultivated in the Deccan and elsewhere in India, but only experimentally except in Burma where it assumes some importance; distributed through Sumatra, Java, and China.

FIBRE. 303

Fibre.—Like the preceding, this species yields a FIBRE, but the plant is collected more on account of its dye than its fibre.

DYE. Leaves. 304

Dye.- The LEAVES of this climber yield INDIGO. This fact has been published repeatedly, but apparently never put to commercial test. On this subject Roxburgh wrote:—"The leaves of this plant yield Indigo, as mentioned by Mr. Marsden, and by Mr. Blake, in the first volume of the *Asiatick Researches.* I have also extracted it from them by hot water. The few experiments I have yet made do not enable me to say positively in what proportion they yield their colour, but it was of an excellent quality; and as the plant grows very readily from layers, slips, or cuttings, I think it very well worthy of being cultivated, particularly as it is permanent like the Nerium" (Wrightia tinctoria), "so that a plantation once formed will continue for a number of years; and if we are allowed to draw a comparison between the leaves of this plant and those of Wrightia tinctoria, the quantity of colour they may yield will be in a larger proportion than that from the common indigo plant." "Some more experiments I have made with the leaves confirm what is above related, not only respecting the quality of the Indigo, but also that the proportion is considerably greater than is obtained from Indigofera tinctoria. I have, therefore, warmly recommended an extensive cultivation thereof."

Indigo. 305

Throughout the *Journals of the Agri.-Horticultural Society* the subject of Marsdenia Indigo is here and there referred to, but up to date no advancement seems to have been made towards utilizing the substance. For example, a sample was communicated in 1844 by Mr. E. O'Riley of Tenasserim to the Society. Commenting on that sample Griffith gave the extract from Marsden's *History of Sumatra* alluded to above by Roxburgh. "There is another kind of Indigo, Marsden says, called in Sumatra *taram akar,* which appears to be peculiar to that country, and was totally unknown to botanists to whom I shewed the leaves upon my return to England in the beginning of the year 1780. The common kind is known to have small pinnated leaves growing on stalks imperfectly ligneous. This, on the contrary, is a vine, or climbing plant, with leaves from three to five inches in length, thin, of a dark green, and in the dried state discoloured with blue stains. It yields the same dye as the former sort; they are prepared also in the same manner, and used indiscriminately, no preference being given to the one above the other, as the natives informed me; excepting inasmuch as the *Taramakar,* by reason of the largeness of the foliage, yields a greater proportion of sediment."

Mason alludes to the fact that this indigo plant is, to a certain extent, cultivated by the Karens and sometimes the Burmans. This is said to be a creeper indigenous in some parts of the country and which yields a good indigo, "though not equal to the Ruellia (Strobilanthes) indigo." Drury, upon what authority is not known, says: "M. tinctoria is cultivated in

Northern India, being a native of Sylhet and Burma. The leaves yield more and superior indigo to the **Indigofera tinctoria**, on which account it has been recommended for more extensive cultivation." This would appear to be a too liberal reading of **Roxburgh's** statement. No record exists of its being cultivated in Northern India and Bengal except, perhaps, the plants raised by **Roxburgh** in the Botanic Garden, Calcutta. This subject has too long remained, however, in obscurity: it would seem well worthy the attention of planters. If any one of the three species of **Marsdenia** could be grown with the double object of affording dye and fibre, it seems probable the maceration to extract the indigo might prove an initial stage in the separation of the fibre, and thus render it possible to cheapen both products. The fibre of **Marsdenia** is of such extreme fineness and strength that, if produced commercially, Rhea and China grass would most probably be driven out of the market. It seems probable that, in India at least, the **Bœhmeria** fibres will never become important crops. The **Marsdenias** are natives of this country, could be readily cultivated by cuttings, and, being perennials, they might be grown at small cost. Every thing in fact points to the superior claims of these plants over almost any other of known economic value which has not as yet found a place in European commerce.

MARSILEA, *Linn.*

A genus of Cryptogams named in honour of **Count Marsigli**, the founder of the Academy of Science at Bologna.

306 **Marsilea quadrifolia**, *Linn.; Baillon, Traité de Botanique, Médicale Cryptogamique, 39;* MARSILEACEÆ.

Vern.—*Súsni-shak*, BENG.; *Chatom aruk*, SANTAL; *Pafil*, KASHMIR; *Tripattra, godhi*, PB.; *Mudugu támara, munugu támara, chick-lintakura, chitlinta kúra* (according to **Elliot**), TEL.; *Chitigina soppu*, KAN.

References.—*Roxb., Fl. Ind., Ed. C.B.C., 745; Voigt, Hort. Sub. Cal., 739; Thwaites, En. Ceylon Pl., 378; Dalz. & Gibs., Bomb. Fl., 309; Stewart, Pb. Pl., 265; Burmann, Fl. Ind., 2·7; Grah. Cat. Bomb. Pl. 243; Elliot, Fl. Andhr., 117, 120; Stewart, Journ. Bot. Tour in Hazára (in Journ., Agri.-Hort. Soc. Ind., Vol. XIV., 6); Rev. A. Campbell, Rept. Econ. Prod., Chutia-Nagpur, No. 7889; Atkinson, Him. Dist., 322; Jour. As. Soc., P. II., No. II., 1867, 81; Gazetteers:—N.-W. P., I., 86; IV., lxxv; Mysore and Coorg., I., 71; Indian Forester, XIV., 390.*

Habitat.—This sub-aquatic plant (closely allied to the ferns) is found growing abundantly on the margins of tanks in Bengal and northwards to the Panjáb, also on the hills up to 5,000 feet.

FOOD. Pot-herb. 307 **Food.**—It is regularly eaten as a POT-HERB by the natives of Bengal, and probably in the Panjáb and other parts of India. The same species occurs in France where, according to **Baillon**, it is eaten in times of scarcity. Two other species, **M. hirsuta**, *R. Br.* and **M. Drummondii**, *R. Br.*, form the well-known *nardé*, of Australian writers, so often mentioned as furnishing food to travellers in that country. From these a sort of coarse bread and a gruel or broth are made. **Mr. J. H. Maiden** (*Native Plants of Australia, 135*), says that the *Nardé* "is much relished by stock. It is, however, better known as yielding an unsatisfactory human food in its spore-cases."

MARTYNIA, *Linn.; Gen. Pl., II., 1055.*

308 **Martynia diandra**, *Glox.; Fl. Br. Ind., IV., 386;* PEDALINEÆ.

TIGER CLAW OR DEVIL'S CLAW.

Vern.—*Hathajori, bichu*, HIND.; *Bagh nakhi*, BENG.; *Sher nál*, BEHAR; *Bag lucha*, SANTAL; *Sher nás (tiger-claws)*, N.-W. P.; *Bichú, hatha*

jori (=fruit), PB.; *Vinchú* (Poison: scorpion), BOMB.; *Vinchú*, MAR.; *Garuda mukku* (hawk's beak), *télu kondi chettu* (Scorpion's tail), TEL. All the above vernacular names are clearly of modern origin and denote the hooked fruit.

References.—*Roxb., Fl. Ind., Ed. C.B.C., 496; Stewart, Pb. Pl., 149; Elliot, Fl. Andhr., 58, 180; Rev. A. Campbell, Rept. Econ. Prod., Chutia Nagpur, No. 8166; Dymock, Mat. Med. W. Ind., 2nd Ed., 555; Baden Powell, Pb. Pr., 364; Gazetteer:—Bombay, XV., 439; Indian Forester, XII., App. 18, 28; Indian Agriculturist, Jan. 1889.*

Habitat.—An American weed now common in the Gangetic plains, Chutia Nagpur, Bombay, and elsewhere in India. It is a rank coarse herb with capsules beaked by strong curved spines.

Oil.—The Rev. A. Campbell states that the Santals distil a medicinal OIL from the fruit; he does not mention the purpose for which the oil is, however, used. OIL. 309

Medicine.—The FRUIT is officinal in the Panjáb bazárs (*Stewart*). It is sold in the drug shops as an antidote to scorpion stings, hence the name *Bichu*, HIND., and *Vinchu*, MAHR. Its properties are very likely entirely imaginary, being suggested on the theory of signatures from the resemblance of the sharp hooks of the fruit to the sting of the scorpion, the claws of the tiger, &c. A writer in the *Indian Agriculturist* dwells on this property of antidote to venomous bites and stings. MEDICINE. Fruit. 310

SPECIAL OPINIONS.—§ "The fruit has received the name *Bichu* (scorpion), not from its use in scorpion bites, but its two curved hooks which resemble the tail of the scorpion. It is a useless substance" (*Assistant Surgeon S. Arjun Ravat, L. M., Girgaum, Bombay*).

Mastich or Mastache, see Pistacia Lentiscus, *Linn.* ANACARDIACEÆ. [Vol. VI., Part I

MASTIXIA, *Bl.; Gen. Pl., I., 950.* 311

Mastixia arborea, *C.B. Clarke, Fl. Br Ind. II., 745;* CORNACEÆ.

Syn.—BURSINOPETALUM ARBOREUM, *Wight, Ic., t. 956.*

Vern.—*Diatalia*, CEYLON.

References.—*Thwaites, En. Ceylon. Pl., 42; Beddome, Fl. Sylv., t. 216; Dals. & Gibs., Bomb. Fl., 28; Gamble, Man. Timb., 211; Lisboa, U. Pl. Bomb., 82; Indian Forester, X., 34.*

Habitat.—A large tree with dark green foliage found in Cachar, the Nilghiri Mountains, and in Ceylon at altitudes of from 4,000 to 7,000 feet.

Structure of the Wood.—Said to be of good quality, but no definite information exists regarding it. Beddome remarks that it is very abundant in the dense Western Ghát forests, from Kanara to Cape Comorin. It is thus doubtless of considerable importance to the people, though its properties do not appear to have been investigated. TIMBER. 312

M. tetrandra, *C. B. Clarke; Fl. Br. Ind., II., 745.* 313

Beddome, in reducing *Wight's* Bursinopetalum to Mastixia, referred this name to the above species, remarking that the "tetramerous form is certainly not a distinct species, as both forms occur on one and the same tree." If this opinion be confirmed, the name of the tree should be M. arborea, *Bedd.*

MATRICARIA, *Linn.; Gen. Pl., II., 427.* 314

Matricaria Chamomilla, *Linn.; Fl. Br. Ind., III., 315;* COMPOSITÆ.

GERMAN CHAMOMILE or PERSIAN CHAMOMILE, the true medicinal Chamomile being Anthemis nobilis, *Linn.*; see Vol. I., 264.

Syn.—M. SUAVEOLENS, *Linn.*

Vern.—*Bábunih, babúna, sutelgul* (Trans Indus). Pb.; *Bábúnj*, Guz.; *Bábunaj?*, Arab.; *Bábunah*, Pers. It seems probable that the above names are more frequently given in India to the imported drug Anthemis nobilis (which see), than to this plant.

References.—*Roxb., Fl. Ind., Ed. C.B.C., 605; Stewart, Pb. Pl., 127; Dymock, Mat. Med. W. Ind., 2nd Ed., 448; Flück. & Hanb., Pharmacog., 536; U. S. Dispens., 15th Ed., 196 & 934; Bent. & Trim., Med. Pl., 155; S. Arjun, Bomb. Drugs, 80; Year Book Pharm., 1874, 626; Baden Powell, Pb. Pr., 357.*

Habitat.—A much branched herb found in the Upper Gangetic plain, and distributed to Northern Asia and westwards to the Atlantic.

OIL. 315

Oil.—An essential OIL is obtained by distillation, which, to a certain extent, possesses antispasmodic properties.

MEDICINE.

Medicine.—It does not seem necessary to do more than indicate the literature of this drug. It is in India, as in Europe, only used as a substitute for true chamomile, and though it might be easily supplied at less price than the imported article, it is scarcely, if at all, used in India. The

Flower heads. 316

dried FLOWER HEADS are officinal, and are said to be stimulant, tonic, and carminative. They are employed in constitutional debility, hysteria, dyspepsia, and intermittent fevers. The warm and strong infusion of the flowers is emetic, while a weak infusion acts as a tonic and febrifuge.

OIL. 317

In flatulence and colic, chamomile OIL is generally regarded the most effectual of all remedies. The *Indian Pharmacopœia* says the *babunaka phul* forms a perfect substitute for the European Chamomile (*see* Anthemis nobilis). "In Persian works the flowers are described as stimulant, attenuant, and discutient. There is a popular opinion among the Persians that the odour of the flowers induces sleep and drives away noxious insects; they also say that the chamomile tea applied to the genitals has a powerfully stimulating effect" (*Dymock*).

MATT, COBALTIFEROUS.

318

Matt, Cobaltiferous.

Since the date on which the article *Cobalt* was written, an interesting correspondence has taken place regarding the "*cheep*" or cobaltiferous matt found in certain parts of Nepal. As this is of some interest, the opportunity has been taken to refer shortly to the subject in this place, leaving the reader, for a full detail of the correspondence, to consult the *Selections from the Records of the Government of India, Revenue and Agricultural Department, Vol. I., 61*, or the *Indian Agriculturist, November 1889, 663*. In January 1888 a parcel of "*cheep*" was forwarded by a Mr. Ricketts to the Resident in Nepál with the information that "there were several smelting mines of the stuff, and that it is only obtained close by the copper mines in Nepal." The name of the locality is "Kachipatar, Argah Zillah, Sowrobhar, about 80 miles north of Doolho. The price on the spot is R30 to R35 per maund, and they sell it here" (at Doolho) "from R40 to R50 per maund." A sample sent from the Resident in Nepál to the Government of India, Revenue and Agricultural Department, was subjected to an analysis and thus reported on by the Director, Geological Survey of India: "The sample of 'cheep,' sent to you by Mr. Ricketts in June last, and forwarded to this office, has been analysed by Mr. E. J. Jones with the following result:—

Loss at 100°C	0·40	Cobalt	13·97
Insoluble in acids	0·50	Iron	65·82
Sulphur	20·41		

Dr. W. King then stated that, from latest available information, cobal oxide was worth £717 per ton; that 5 tons of "cheep" would yield 1 ton o

the oxide, and at Mr. Ricketts' valuation could be obtained for from £270 to £455; and that, therefore, there appeared to be a fair margin to allow of the matt being profitably exported if obtainable in sufficient quantity. In answer to this report the Resident of Nepál stated that, according to Mr. Ricketts, the present supply is about 400 maunds a year, and that this might, in all probability, be increased by a greater demand.

Since the date of the last letter (October 1889), no record exists of any attempt having been made to export the "matt."

MATS AND MATTING.

319

Mats and Matting.

Syn.—MATTEN, *Dut., Ger.*; NATTES, *Fr.*; ESTEIRAS, *Port., Sp.*; STUOJE, STOJE, *It.*; PROGOSHKI, *Rus.*; HASSIR, *Turk.*

Vern.—*Chattai*, HIND.; *Motha*, KUMAON; *Chatái*, PB.; *Chattai*, GUZ.; *Tikar, bogor, galeran, klasa*, MALAY.

References.—*Stewart, Pb. Pl., App., 93; The Journal of Indian Art, III., 10, 14; Report of Commercial Conference, Colonial and Indian Exhibition, 3; Baden Powell, Pb. Pr., 517; Pb. Manufactures, 85, 303; Royle, Fib. Pl., 234; Birdwood, Indian Arts, II., 298; Mukharji, Art Manufactures of India, 310; Grierson, Behar Peasant Life, 150; Balfour, Cyclop., II., 896; Settlement Reports; Central Provs., Upper Godáveri Dist., 43, 44; Panjáb, Pesháwar Dist., 19; Muzaffargarh Dist., 103; Manuals:—Madras Administration, I., 361; Cuddapah Dist., 53; Admn. Reports, Bombay, 1871-72, 369, 398; Reports (official):—Kumáon, 280.*

It is not intended to deal in this work with the subject of Mats and Matting further than to afford a key by which the reader may be able to discover the chief materials employed in their construction. The references given above may, however, prove useful to persons desirous of discovering detailed accounts of the various methods pursued in manufacturing mats. Sir George Birdwood alludes very briefly to some of the more famous mats, such as those of Pálghát on the Malabar coast; Midnapur, "admired for their fineness and classical designs of the mosaic-like patterns of stained glass"; *Sitalpati* or Eastern Bengal cooling mats, used for sleeping on; *darmá* employed in Bengal in the construction of huts: *Sedge* or *Mádur* mats much prized for carpeting floors: and Sylhet ivory mats. But there are many others, such as palm mats, bamboo mats, reed mats, *dib* or Typha mats, Aloe and *Munj* mats, &c., &c.

The following are the more important plants used in mat-making:—

Agave americana, *Linn.*

Aloe fibre mats are now largely made in Madras, Hazáribágh, Bulandshahr, &c.; Vol. I., 140.

Arundhinaria falcata, *Nees*; Vol. I., 335.

A stunted Himálayan bamboo.

Bambusa, Dendrocalamus, and other forms of bamboo; Vol. I., 387.

Some of the finer coloured bamboo mats met with in India are prepared in Midnapur and Madras. In some parts of Bengal, bamboo matting is used in the construction of huts in place of *Darma*, and in Burma, Assam, and the North-Western Provinces this is nearly always the case.

Borassus flabelliformis, *Linn.*; Vol. I., 504.

Calamus, several species, but chiefly **C. Rotang**, *Linn.*

Cane mats, see Vol. II., 98-102 (*Conf.* with *Hoey, Trade and Manuf. N. Ind., 72-75*).

Cocos nucifera, *Linn.*

Two kinds of mats are made from this palm—one, and by far the most important, from the coir (see Vol. II., 432); the other, by plaiting the leaves to form what are known as *Cadjans* (see *Vol. II., 433*).

Cyperus, various species of Sedge, but chiefly C. tegetum, *Roxb.*
From this the *midur* grass mats of Calcutta are made. In Madras C. corymbosus, *Roxb*, takes its place. The species employed in making the *Masland* mats of Midnapur has not apparently been determined (see Vol. II., 682-689).

Gossypium—Cotton. See Carpets and Rugs; Vol. II, 176-182.

Hedychium spicatum, *Ham.*; Vol. IV., 207.
On the Himálaya the dry leaves of this plant are twisted and woven into the ordinary sleeping mats used by the hill people.

Ischœmum angustifolium, *Huck.*; Vol. IV., 527.
Bhábar mats are largely made in some parts of the North-West Provinces.

Licula peltata and Livistona Jenkinsiana; Vol IV., 630.
Two palms met with in Assam and Burma, yield leaves which are largely used for mats, umbrellas, &c.

Nannorrhops Ritchieana, *Wendl.*; p .
The palm used in making the Peshawar, Kohat, and other Panjáb mats, known as *Patta*. These are described by Baden Powell (*Panjáb Manufactures*).

Pandanus odoratissimus, *Willd.*; Vol. VI., Pt. I.
The leaves of the screw pine are largely used for making mats in the localities where the plant occurs, *viz.*, the Andaman Islands, South India, Bengal, &c.

Phragmites Roxburghii, *Trim.*; Vol III., 27; also VI., Pt I.
The substance from which the *Darma* mats of Bengal are made,—not bamboo, as stated by T. N. Mukharji in *Art Manufactures*.

Phœnix dactylifera and P. sylvestris; Vol. VI., Pt. I.
The leaves of the various forms of date-palm are extensively platted into mats, and by the well-to-do people these are often spread on floors beneath other better-class mats or carpets (*Baden Powell, Panjáb Manufactures*).

[illegible] an interesting [illegible] mats of Nepal. As the "*cheeb*" [illegible]

Phrynium dichotomum, *Roxb.*; Vol. VI., Pt I.
This plant has, by most modern writers on Economic Products, been incorrectly referred to Maranta. Its real position is more probably in the genus Clinogyne, *Salisb.* From the stems of this plant the famous *Sitalpáti* mats of Eastern Bengal are prepared.

Saccharum cilinre, *Anders.*; Vol. VI., Pt I.
By the most recent botanical investigations, this species has now been made to include the two forms known in Indian works on Economic Botany as S. Munja and S. Sara. From the former and, to a small extent, from the latter, also, the famous *Munj* mats and carpets are made. The industry in these mats is mainly confined to the jails of Upper India, as for example Delhi, Allahabad, Lucknow (*Conf.* with *Hoey, Trade and Manuf. N. Ind.* 65).

Scirpus (Malacochæte pectinata, *Nees.*); Vol. VI.
The plant used in making Kashmir mats.

Typha angustifolia, *L.*; and T. latifolia, *Willd*; Vol. VI., Pt. II.
These aquatic plants afford leaves which are regularly employed in making mats. In Bengal these are known as *hogla* and in the Panjáb as *d.b* mats.

Wool, Hair, &c.; Vol. VI., Pt. II.
Many of the finer qualities of mats are felted or woven from these materials, but, as they are nearly always highly ornamental, they are art manufactures and would not, therefore, be treated of in this work.

There are doubtless other materials used, especially among the hill tribes of Assam, but the above embraces the more important matting as well as basket materials.

MATTHIOLA, *Br.; Gen. Pl., I., 67.* 320

Matthiola incana, *R. Br.; Fl. Br. Ind., I., 131;* CRUCIFERÆ.
PURPLE GILLY FLOWER or COMMON STOCK.

Vern.—*Todrí saféd, todri lila,* PB.; *Todri safed,* SIND.

References.—*Dals. & Gibs., Bomb. Fl., 4; Stewart, Pb. Pl., 14; Pharmacog. Ind., I., 120; Dymock, Mat. Med. W. Ind., 56; Murray, Pl. and Drugs, Sind, 48; Balfour, Cyclop. Ind., III., 507.*

Habitat.—Cultivated as a cold season garden annual throughout India, but on some parts of the Himálaya it becomes a perennial. M. odoratissima, *Br.*, is a common indigenous species on the higher ranges of the N.-W. Himálaya.

Medicine.—The SEEDS are of three kinds—yellow, red, and white; used in infusion in cancer; are expectorant; mixed with wine given as an antidote to poisonous bites (*Dr. Emerson*). According to Stewart these seeds constitute one of the kinds of *todrí* which are reckoned aphrodisiac. MEDICINE. Seeds. 321

[*p. i., ii.*

MAYODENDRON, *Kurz, Prelim. Forest Rept. Pegu, App. D.,* 322

[NIACEÆ.

Mayodendron igneum, *Kurz; Fl Br. Ind., IV., 382;* BIGNO-

Syn.—SPATHODEA IGNEA, *Kurz, Jour As. Soc. Beng. (1871), Pt. II., 77.*

Vern.—*Mawkpyit,* SHAN; *Ekarit,* ? BURM.

Habitat.—A tall tree with a girth of about five feet, found in Martaban and distributed to Ava and Yunan. Mr. Oliver, Conservator of Forests, Upper Burma, has recently furnished a specimen of this tree, together with the above vernacular names. He remarks that it occurs in the moist forests of the Namyin valley.

Structure of the Wood.—Definite information does not exist regarding the timber of this tree, but presumably, like the other members of the order to which it belongs, it is soft and of inferior quality. TIMBER. 323

Meadow saffron, see Colchicum autumnale, *Linn.;* LILIACEÆ Vol. [II., 501.

Mecca Balsam, see Balsamodendron Opobalsamum, *Kunth.;* BURSE- [RACEÆ, Vol. I., 369.

MECONOPSIS, *Vig.; Gen. Pl., I., 52.*

Meconopsis aculeata, *Royle, Ill. Him. Bot. 67, t., 15 (colour of flowers wrongly shown as pink); Fl. Br. Ind.; I., 118;* PAPAVERACEÆ. 324

Vern.—*Guddi kúm* (JHELUM), *Gúdi* (RAVI), *Kanda'* (SUTLEJ), *Kanta* (SIMLA), *Pb.*

References.—*Stewart, Pb. Pl., 69 · Bot. Mag. t. 5456; O'Shaughnessy. Beng. Dispens., 184; Pharmacog. Ind., I., 112; Gazetteers:—N.-W. P., X., 304; Panjáb, Simla District. 12.*

Habitat.—A spiny herbaceous plant with pale blue flowers; found in the Western Himálaya from Kashmír to Kumáon, at altitudes of from 10,000 to 15,000 feet.

Medicine.—The ROOT is officinal in Kashmír as a narcotic, and is in Chumba regarded as poisonous. O'Shaughnessy mentions having given a drachm of an alcoholic extract to a dog without producing any perceptible effect. MEDICINE. Root. 325

MECONOPSIS Wallichii. — The Himalayan Purple Poppy.

326

Meconopsis nipalensis, *DC.; Fl., Br. Ind., I., 118.*

Syn.—PAPAVER PANICULATUM, *Don.*

References.—*Pharmacog. Ind., I., 112; Gazetteer, N.-W. P., X., 304; Honigberger, Thirty-five years in the East, II., 306, 352.*

Habitat.—Found in the temperate Himálaya at altitudes from 10,000 to 12,000 feet. in Sikkim and Nepál.

MEDICINE. Root. 327

Medicine. —According to Honigberger the ROOT is officinal in Kashmir, being regarded as a narcotic.

M. Wallichii, *Hook.; Fl. Br. Ind., I., 119.*

Habitat.—A slender, stellately pubescent and softly hairy plant, met with in the Temperate Himálaya at altitudes of 9,000 to 10,000 feet.

MEDICINE. Root. 328

Medicine.—It seems that this and the two preceding species possess similar properties. The authors of the *Indian Pharmacographia* appear to have examined the ROOT of the present species, and their analysis may, therefore, be here reproduced as expressing all that is known regarding these Indian drugs.

CHEMICAL COMPOSITION.—"The root dried by exposure to air, and reduced to a fine powder, lost 8 per cent. of moisture at 100°C. The ash amounted to 12·7 per cent., and contained a marked amount of manganese. The alkalinity calculated as KHO, after separation of lime, was equal to 8·6 per cent. Digested with light petroleum ether, ·48 per cent. of a pale yellow, viscid, transparent, odourless extract was obtained. With the exception of a few white flocks the extract was soluble in absolute alcohol. On spontaneous evaporation shining lamina separated, which under the microscope consisted of rhombic plates and needles: oil globules were also visible. The alcoholic solution of the extract was strongly acid. The amount of crystalline matter was too small to admit of the nature of the fat acid being determined. After exhaustion with light petroleum ether, the powder was dried by exposure to air, and then digested with ether. On evaporating off the ether, ·41 per cent. of a fragrant, soft, indistinctly crystalline residue was left. The extract was heated with dilute hydrochloric acid, and the soft, yellow, insoluble residue separated by filtration. The acid solution was rendered alkaline with ammonia, and then agitated with ether. On separation of the ether only a minute trace of residue was left, which did not respond to alkaloidal reagents. The yellow residue insoluble in HCl was treated with ammonia, and the turbid mixture agitated with ether. The ether left on evaporation a yellow, soft, non-crystalline residue, without taste or odour, which had the properties of a neutral resin. The aqueous alkaline solution after the separation of the ether, yielded yellow flocks when treated with dilute acids, which were re-dissolved by alkalies: this principle had the properties of a resin acid. The fragrant odour of the etherial extract was probably due to a trace of benzoic acid.

"After treatment with ether the powder was again dried, and then digested with absolute alcohol. The alcoholic solution was of a pale greenish colour, and possessed a marked greenish-yellow fluorescence; examined spectroscopically no absorption bands were visible. On evaporation, the alcoholic solution yielded 1·07 per cent. of extractive, yellow in colour, and possessing a somewhat fragrant odour. The extract was partly soluble in water. The aqueous solution did not possess any particular taste; it yielded slight precipitates with alkaloidal reagents; with ferric chloride no coloration was produced. On evaporation and ignition a trace of ash was left, possessing an alkaline reaction. The portion of the alcoholic extracts insoluble in water, dissolved in alcohol, yielding a greenish solution,

with acid reaction, and greenish-yellow fluorescence. The powder, after treatment with alcohol, yielded 12 6 per cent of extractive to cold water. The aqueous solution was yellowish-brown in colour; alkaline in reaction it afforded no coloration with ferric chloride; it slightly reduced alkaline solution of copper on boiling." MEDICINE.

MEDICAGO, *Linn.; Gen. Pl., I., 487.* 329

Medicago denticulata, *Willd.; Fl. Br. Ind., II., 90;* LEGUMINOSÆ.

Syn.—M. CANESCENS, *Grah.;* M. POLYMORPHA, *Roxb.*

Vern.—*Mainá*, PB.

References.—*Roxb., Fl. Ind., Ed. C.B.C., 589; Stewart, Pb. Pl., 71; Murray, Pl. and Drugs, Sind, 114; Gaz. N.-W. P. (Bundelkhand), I, 80; (Agra) IV., lxx, Agri.-Hort. Soc. Jour., XIV., 9.*

Habitat.—A field weed in the plains and low hills of Bengal, North-West Provinces, Oudh, the Panjáb, and Sind. Distributed to Abyssinia, Europe, Japan, China, &c.

Fodder.—It is largely gathered for cattle-fodder, as it is considered good for milch cows. Stewart remarks that it is said to be cultivated. (See *Vol. III., 416.*) FODDER. Herb. 330

M. falcata, *Linn.; Fl. Br. Ind., II., 90.* 331

YELLOW LUCERNE.

Syn.—M. SATIVA, *Wall.; Cat. No. 5945 C.D.;* M. PROCUMBENS, *Besser.*

Vern.—*Rishka, hol*, AFG., LAHOUL.

References.—*DC. Origin Cult. Pl., 102; Best Forage Plants by Stebler and Schroter, Transl. by A. W. McAlpine, 147; Birdwood, Bomb. Pr., 126; Report, Agri. Dept., 1881-82, 236.*

Habitat.—A sub-erect perennial, met with in Kashmír, Ladak, and Kunáwar, at an altitude of from 5 to 13,000 feet. Distributed to Afghánistán, Persia, and Europe.

M. lupulina, *Linn.; Fl. Br. Ind., II., 99.* 332

THE TREFOIL.

References.—*Stewart, Pb. Pl., 71; Best Fodder Plants by Stebler and Schröter, Transl. by McAlpine, 153; Permanent & Temporary Pastures by Sutton, 71; Atkinson, Him. Dist., 308; Gaz. N.-W. P. (Bundelkhand), I., 80; (Agra) IV., lxx; Jour. Agri.-Hort. Soc. Ind., XIV., 9.*

Habitat.—A native of the tropical and temperate tracts of the North-West Himálaya, ascending from the Indus valley and Gangetic plain to 10,000 or 12,000 feet in altitude.

Fodder.—A common WEED, collected frequently for fodder. Its flowers resemble hop cones, hence its specific name. It mixes well with grasses and clovers for artificial pastures. FODDER. Herb. 333

M. sativa, *Linn.; Fl. Br. Ind., II., 90.* 334

LUCERNE or PURPLE LUCERNE.

Syn.—Some difference of opinion prevails as to the Botanical position to be assigned to the cultivated forms of Lucerne. The *Flora of British India* suggests that **M. sativa** may be but a cultivated state of **M. falcata**, characterised by the pod forming a double spiral and by the flowers being usually purple. Many writers, however, regard **M. sativa**, **M. falcata** and **M. media** as forming but one species, while others depart so far from that position as to admit the forms indicated as varieties under one common species, and still others hold that all three are distinct. On the other hand, by still a further series of authors **M. media** is pronounced a hybrid between **M. sativa** and **M. falcata**. Whatever botanical view be taken, **Stebler** and **Schroter** very justly add that to the agriculturist the three forms of Lucerne are very distinct, both in yield and suitability to environment. The Indian literature of the subject is, however, too imperfect to allow of a critical account being written. An attempt has, therefore, been here

made to refer all available information given under any of the species of Medicago indicated above, to its specific position, but to compile the general information into the concluding account of Lucerne irrespective of the plant or plants meant.

Vern.—*Wuayti-gawuth*, HIND.; *Hol*, LADAK; *Spastu*, PUSHTU; *Sebist, rishta, dureshta*, AFG.; *Yurushea* (green) and *beda* (dry), YARKAND; *Vilayti-ghas*, GUZ.; *Vilayti-hullu*, KAN.; *Alfafa, alfasafat, alfalfa, fisfisat*, ARAB.; *Isfist*, PERS.

References.—*Dale. & Gibs., Bomb. Fl. Supp., 21; Stewart, Pb. Pl., 71; DC. Origin Cult. Pl., 102; Aitchison, Bot. Afgh. Del. Comm., 48; Saidapet Exp. Farm. Manual, 53; Murray, Pl. and Drugs, Sind, 113; Atkinson, Him. Dist., 305; Liboa, U. Pl. Bomb., 277; Birdwood, Bomb. Pr., 126; Royle, Prod. Res., 220; Smith, Dic., 270; Bomb. Man. Rev. Acc., 102; Gaz. Bombay, V., 25; N.-W. P. III., 225; Mysore and Coorg, I., 59; Indian Agri. Sept. 7th, 1889; Indian Forester, X., 111; XIV., 347; Agri. Dept. Reports (Exp. Farms). Madras, 1877-78, 16 & 97; Hyderabad, Sind, 1885-86, 31; 1886-87, 7; 1887-88, 3; Agri.-Hort. Soc. of India, Transactions & Journals quoted below.*

LUCERNE.

Habitat.—De Candolle says of this plant: "It has been found wild, with every appearance of an indigenous plant, in several provinces of Anatolia to the south of the Caucasus, in several parts of Persia, in Afghánistán, in Baluchistán, and in Kashmír. In the south of Russia, a locality mentioned by some authors, it is, perhaps, the result of cultivation, as well as in the south of Europe. The Greeks may therefore have introduced the plant from Asia Minor, as well as from India which extended from the north of Persia. This origin of lucerne, which is well established, makes me note, as a singular fact, that no Sanskrit name is known. Clover and sainfoin have none either, which leads us to suppose that the Aryans had no artificial meadow." Stebler and Schroter state that lucerne is indigenous to the following countries "Asia, Anatolia, Southern Caucasus, Persia, Afghánistán, Baluchistán, and Kashmír."

HISTORY. 335

History.—Lucerne was known to the Greeks and Romans: they called it in Greek *medicai*, in Latin *medica* or *herba medica*, because it was brought from Media at the time of the Persian war, about 470 years before the Christian era. The name lucerne is sometimes supposed to be derived from the valley of Luzerne in Piedmont. De Candolle, however, suggests a more rational derivation. "The Spaniards," he says, "had an old name, *ervye*, mentioned by J Bauhin, and the Catalans call it *use das*, whence, perhaps, the *patois* name in the south of France, *laduzerdo*, nearly akin to *luzerne*." "It was so commonly cultivated in Spain that the Italians have sometimes called it *herba spagna*. The Spaniards have, besides the names already given, *mielga*, or *melga*, which appears to come from Medica, but they principally used names derived from the Arabic—*alfafa, alfasfat, alfalfa*." The botanical evidence favours the inference derivable from the names of the plant, namely, that its original habitat extended from the north-west frontier of India to the shores of the Mediterranean. The writer possesses in his private herbarium many sheets of M. falcata, collected from undoubtedly wild sources in Persia, Kashmír, Chamba, &c., and from cultivation in many localities on the plains of India, more especially Behar. Of M. sativa, one sample bears no remark as to its being wild or cultivated, namely, that collected by Dr. Giles, during the Gilgit expedition; all the others from Baluchistán collected by Mr. Lace, from the plains of India, &c., are expressly stated to have been collected from fields. The *Flora of British India* states that M. sativa is grown for forage in Madras, Bengal, and the North-West Provinces. The *Transactions, and Journals of the Agri.-Horticultural Society of India*, in this case as in many others, throws the most direct light on the origin of the Indian forms of

HISTORY.

lucerne. We read, for example, in the *Transactions* (*Vol I, 72, 79*) that Mr. W. Moorcroft noticed the variability of the flowers in the wild plant. His remarks are so interesting as to justify our republishing them here. He wrote, speaking of the higher ranges of Lama Yooroo in Kashmír: "I witnessed so striking a difference between the condition of the yellow lucerne near the summits of the dry mountains of Lama Yooroo (Ladak) and of the same plants when skirting the water-courses of Drass as might almost have countenanced a suspicion that there was a greater difference than what arose from locality alone." In a foot-note to the above it is stated:—"Lucerne in its natural state bears a yellow flower of a rich scent and is of great longevity; under the influence of cultivation it runs through a diminished sulphur tint into whiteness, becomes green with a stain of red, and settles permanently in pink and purple; it also loses its fragrance and becomes short-lived." Mr. Moorcroft then alludes to the cultivation of lucerne in Pusa (1823), remarking, "I caused the Government to expend considerable sums in wells and other arrangements for the watering of lucerne grounds, of which the supply was hardly ever adequate in the dry season, and the plants of which died when their crowns were long submerged in the rains. The facts I have now seen in regard to the almost aquatic nature of this plant lead to a suspicion that, if a modification of the float system had been adopted on the edges of a river with a very slow current during the largest portion of the year, and which embraced a great portion of the grounds in a crescent, that an immense quantity of excellent forage might have been raised, and the expense of wells, the labour of cattle and of gardeners might have been saved." In a further paper on Prangos hay, Mr. Moorcroft wrote of Imbal or Droz that he found yellow lucerne, a spontaneous product; he wrote of it—"it is of a constitution more hardy than that of Europe, requires no other culture than that necessary for sowing it, and lasts in vigour for a long series of years." He adds, "it is submitted that as it naturally grows along with Prangos, it would be well to imitate this habitude; the joint yield is vastly greater than that of the richest meadow land, and is produced in this country on a surface of a most sterile nature, in regard to other herbage, hence, is respectfully suggested the propriety of furnishing a few pounds of this seed to the Cape of Good Hope to be sown along with the Prangos."

In a report of Karnal (1836) mention is made of the experimental cultivation of lucerne. It is there stated that "the plant thrived well, but being so common no remark seemed necessary." In the Proceedings of the Society for 1838 mention is made of Mr. Hodgson having sent "from Nepal seed of lucerne grass." In the Proceedings for the succeeding year, Lieutenant Nicolson mentions that in the meadows near Kábul lucerne is very commonly grown as food for horses and cattle. This same fact is again alluded to in the Journal (*Vol. I, 105*) when Sir Alexander Burnes gave particulars of the artificial grasses of Kábul including lucerne. Sir Alexander's account of the method of cultivation pursued in Afghánistán will be found in a further paragraph. The subject of Kábul lucerne, however, seems to have attracted considerable interest since in Vol II. (*Selections*), p. 297, we read that "Kelat lucerne, of which a large quantity was furnished by Government six months ago (1843), has been partly sown and partly distributed. It has vegetated well, but I fail to detect the smallest difference between it and our Deccan species Its superior luxuriance at Kelat, &c., must be owing to climate rather than to species." The writer of the passage quoted was Dr. A. Gibson, Superintendent of the Government Botanical Gardens, Bombay, and the allusion to "our Deccan species" is, therefore, extremely interesting as indicating an early cultivation of lucerne in Western India.

Passing over a gap of nearly forty years, we next read, in the *Journals of the Agri-Horticultural Society*, of lucerne as being experimentally grown in the Saidapet Farm, Madras, from English seed. Of Benares, a writer reported the failure of a crop in 1878, and in 1884 lucerne is stated to have done well in Silos. Thus it will be seen that only occasional mention is made of lucerne in India, though enough to prove that its cultivation has been at least tried during the greater part of the past 100 years. In the recent reports of Government Experimental Farms, it is stated that the Australian and European forms were found not to succeed so well as "the country kind known as Púna Lucerne." Even the Púna Lucerne does not seem to have "an entire immunity from the attacks of insects or hurt from the heat, and so many of the plants die during the hot weather that no heavy cutting is ever afterwards got from the plots."

Cultivation of Lucerne.

CULTIVATION. 336

The following interesting account regarding Kábul may be here given. Sir Alexander Burnes wrote in 1841:—"There are three kinds of grasses cultivated in Kábul—*rishku*, or lucerne; *shuftul*, or a kind of trefoil; and *sibarga*. The first and the last continue to yield crops for some years, but the trefoil (*shuftul*) is an annual.

The lucerne (*rishku*) is sown in spring, generally about the vernal equinox; for each *jureeb* (or about half an English acre) two seers of Kabul (or about 28lb English) are required as seed. In forty days it comes to perfection and is cut down, and will yield four full-grown crops ere winter sets in, but by early cutting six or eight crops may be drawn,—the last may sometimes be inferior from premature cold. One *jureeb* yields on an average ten camel-loads of grass at each cutting; as a camel carries about 500lb, this is a produce of 5,000lb the *jureeb* or 10,000lb the English acre; and for four or five crops 40,000lb English. The third crop is considered the best, and from it the seed is preserved. Of this the half acre sown with two seers Kábul will yield 40 seers or about 560lb. This plant requires the best black soil, much manure, and is watered five times each crop, in fact whenever it droops. It is sometimes sown along with barley, but in that case the grain by exhausting the soil injures the crop. The seed is never exported, but the grass is so plentiful, though all the cattle are fed on it, as much to exceed the consumption; it is, therefore, dried, and that produced at any distance from a market is generally stored in this manner and sold during the winter. A camel load of it (or about 600lb English), whether green or dry, sells for one Kábul rupee, a coinage of which 115¼ are equal to 100 Company's rupees. Lucerne generally lasts for six years, but it will yield for ten years, if manure be abundantly scattered over it."

In the report of the Mission to Yarkand in 1873, the following further particulars are given which show the importance of lucerne at the present time in Upper India or immediately beyond the frontier:—

"Sown in August and September; sprouts in March and April. Is cut three times in six months, and after each receives a top-dressing of manure, and free irrigation, one sowing lasts three years, after which the roots decay. When sown, the seed is mixed with an equal quantity of barley, otherwise the lucerne does not thrive. It is extensively grown as a fodder crop, and is stored in bundles for winter use."

A writer in the *Indian Forester* (X., 111) says that "in dealing with the important question of fodder-reserves, it is profitable to notice the great success which has attended the cultivation in this country of guinea-grass (*Panicum jumentorum*) and lucerne (*Medicago sativa*). Lucerne is grown in small quantities in most places where Europeans are to be found, but guinea-grass is not so generally known." The writer then adds: "Lucerne

is cultivated with very little difficulty. It should be sown broadcast on ground well broken up and manured. According to Pogson and other authorities, the spring is the best time for sowing, and lime the best manure. The outturn of lucerne varies according to circumstances, and should not be less than that of guinea-grass. In 1883, 4 *bighas* under lucerne at Dera Ghazi Khan produced 930 maunds of green fodder in six months (January to June)." In the *Bombay Gazetteer* for the district of Cutch it is said to be grown as food for horses and to thrive well. In the *Saidapet Manual and Guide* it is stated, "under irrigation this plant produces a large quantity of valuable fodder. A few pounds of English seed sown in September 1869 grew satisfactorily and yielded three cuttings of excellent fodder; it did not appear to be injured by the heat of the sun, though the thermometer exposed in the sun part of the time registered 135°, and the crop then looked vigorous and healthy. A similar result was obtained with some seed sown in 1876." CULTIVATION.

In concluding this account of lucerne it may be said European experience has formulated the following facts regarding successful cultivation:—

1. Dry seasons, and a warm sunny exposure suit lucerne best.
2. The best soil is a warm calcareous one; cold impervious clay being unsuitable.
3. The ground must be kept well cleared of weeds; grass is its greatest enemy.
4. Clean seed must be secured, that is, seed free from admixture with Medicago denticulata, M. maculata, &c.
5. The crop should be reaped before flowering.
6. Its cultivation is remunerative only where the crop can be allowed to grow for at least three years.

MEDICINES.

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The reader is referred to the remarks under Domestic & Sacred (*Vol. III., 191*) for an explanation of this subject heading. Space will not permit of a collective article on Medicines being here given. The magnitude of such a review may be learned from the fact that in the writer's *Catalogue of the Economic Products*, shown at the Calcutta International Exhibition (Vol. V.), 1,248 indigenous drugs of India have been briefly described, making a volume of 503 pages. But doubtless, in the preparation of the material for the present work, that list has been increased to close on 2,500 substances (taking animal, vegetable, and mineral all into account) which have medicinal virtues, rightly or wrongly, assigned to them by the people of India. A bare list of the names of such substances would be comparatively valueless. What might be of value would be a careful classification under Therapeutic sections. This will be found, however, in many works, such as *O'Shaughnessy's Bengal Pharmacopœia*, 113 to 187, *Stewart's Panjáb Plants*, App. 77-106, &c. In the official correspondence conducted in 1880 by the Home Department, Government of India, regarding a proposed new edition of the *Pharmacopœia of India*, much valuable information was brought together regarding the indigenous drugs that might be used for the imported ones, of each therapeutic class. (See also *Lisboa, Useful Plants of Bombay*, being Vol. XXV. of the *Bombay Gazetteer*, pp. 254-263.)

Medlar, Indian, see Pyrus Pashia, *Ham.*; ROSACEÆ; Vol. VI. 338

MEERSCHAUM.

Meerschaum, *Ball, in Man. Geology Ind., 445-446.* 339

This well known substance is a hydrous magnesium silicate. It is chiefly

obtained in Asia Minor, Greece, Moravia, Spain, &c., but Mr. Ball remarks that it would be in no wise a surprise if the magnesite deposits of Salem and the adjoining districts, or the magnesium clays and serpentines of the Nicobar Islands, were found to contain Meerschaum

340 **MELALEUCA**, *Linn.; Gen. Pl., I., 705.*

Melaleuca Leucadendron, *Linn.; Fl. Br. Ind., II., 465;* MYRTACEÆ.

The remarks which here follow are believed to be mainly a compilation of information regarding Cajupat (var. β), but the habitat is that of the type form of the species. It has not been found possible to isolate the economic facts given by authors under the two varieties respectively.

341 Var. α—Leucadendron; *Roxb., Fl. Ind., Ed. C.B.C., 591.*

Syn.—MYRTUS LEUCADENDRON, *Linn.*

References.—*Arbor alba Caju Puti, in Rumph. Amb. Herb., II., 72, t. XVI.*

The *Flora of British India* remarks that this form is cultivated in India, and Roxburgh informs us that it was introduced into the Royal Botanic Gardens, Calcutta, in 1811. It is a much larger tree than the next form—the true Cajuput-oil tree. It would, however, seem desirable to ascertain if the oil, even though of inferior quality, could be obtained from this tree since the uses of the oil in arts might be thereby greatly extended.

Var. β—minor; *Roxb., Fl. Ind., Ed. C.B.C., 590.*

342 The Cajuput-oil of commerce is apparently prepared from this form.

Syn.—M. MINOR, *Sm.*; M. CAJUPUTI, *Roxb.*; M. LEUCADENDRON, *Lam.*; M. VIRIDIFLORA, *Gærtn.*; M. SALIGNA, *Blume.*; M. CUMINGIANA, and LANCIFOLIA, *Turcz.*

References.—*Arbor alba minor Cajuputi*, RUMPHIUS. *Amb Herb., II., 76, t. XVII.*; *Roxb., Fl. Ind., Ed. C.B.C., 590. Roxburgh says this plant has been grown in the Royal Botanic Gardens, Calcutta, since 1797-98.*

Collective References, &c., to both forms.

Vern.—*Kayaputi*, HIND.; *Cajuputte, ilachie*, (PATNA) BENG.; *Kéydkuti*, BOMB.; *Cajupûti*, MAR.; *Kajâpûté, kayapûte*, TAM.; *Cajuputi, kâyu pûtia*, MALAY.; *Tram*, COCHIN-CHINA.

References.—*Roxb., Fl. Ind., Ed. C.B.C., 590-592; Roxb., Trans. London Med. Bot. Soc., 1829; Voigt, Hort. Sub. Cal., 45; Kurz, For. Fl. Burm., I., 472; Pegu Rept.*; LX Gamble, *Man. Timb., 188; Mason, Burma and Its People, 491, 744; Laureiro, Flora Cochin-China, II., 468; Pharm. Ind., 90; British Pharm. (1885), 284, 380; Flück. & Hanb., Pharmacog., 777, 778; U. S. Dispens., 15th Ed., 1003; Fleming, Med. Pl. & Drugs (Asiatic Rese. XI) 184; Ainslie, Mat. Ind., I., 259; O'Shaughnessy, Beng. Dispens., 307; Irvine, Mat. Med. Patna, 24; Sakharam Arjun, Cat. Bomb. Drugs, 46; Bent. & Trim., Med. Pl., 108; Dymock, Mat. Med. W. Ind., 2nd Ed., 331; Year Book Pharm., 1874, 632; 1879, 476; Med. Totog., Ajm., 132; Watt's, Dict. Chemistry, Vol. I., 710-713; VII., 231; VIII., 370; Birdwood, Bomb. Prod., 36; Crawford History of the Indian Archip., I., 513; Gazetteers:—Burma, I., 131; Mysore and Coorg, I., 69; Indian Forester, VI., 124; XI., 274, 275, 277.*

Habitat.—An evergreen tree, often of large size, found in Tenasserim, Mergui, and Malacca; distributed to the Malay Islands and Australia.

HISTORY, OIL. 343 History.—The account given by Flückiger & Hanbury on this subject and indeed not of the history only but of every feature of Cajuput has been practically reproduced by all subsequent writers. Ainslie (of what may be called modern authors) appears to have been the first Indian writer who described the drug, as Roxburgh was the first botanist who drew attention to the peculiarities of the plant. Both these writers quote freely from Rumphius, the Governor of Amboyna, who studied the plants found in the Dutch East Indies, between 1627-1702. Rumphius gave a detailed

History and Medicinal uses of Cajuput. (*G. Watt.*) MELALEUCA Leucadendron.

account of the uses of this plant and the preparation of its aromatic oil. The wood, he says, is fragile and not of much use for building purposes. The fruit, seed, and leaves have a strong aromatic odour and hence they are used as an aromatic and stomachic tonic. The people of Java, however, prepared from them many special medicines called *dju-djambu* which were employed for so many diverse diseases that it was difficult to say what their exact action might be. Some of these potions were, however, specially serviceable for checking debility and putting the stomach to rights. Others were valuable in the treatment of convalescent women after childbirth, as they tend to contract the internal organs. Men praise, Rumphius continues, preparations of this drug as valuable in the treatment of cephalalgia, but of this property, he remarks, definite proof has not as yet been adduced. The Amboyans also use the leaves, which they macerate with the flowers in new oil, and afterwards impregnate it with the smoke of benzoin and other aromatics. Of this they make their *Minjac mony*, that is, the perfumed oil with which they anoint their heads. Certain Javanese and Malays also fill their pillows with these leaves for the sake of the pleasant odour, but this to our notion, adds Rumphius, is far too strong. The leaves collected on a warm day and dried in the open air are also placed in their clothes' chests to drive away various insects through their powerful odour. To increase this action the leaves are often rubbed between the hands which causes a more liberal discharge of their cardamom-like odour. It is said also that the pillows filled with these leaves drive vermin out of bedsteads. The fruits are collected and sold separately in sweet-smelling baskets. The fruit is, in fact, the part of the plant mainly used in the preparation of the medicinal potions, but these preparations are always made up with other ingredients.

HISTORY.

The leaves, if collected on an exceptionally warm day and placed within sacks, even though they be quite dry, burn with such a vehemence as to become moist, almost as if they had been macerated in water. If, however, they are treated differently and macerated in water, so that they ferment during night, and if they be then distilled, an oil is extracted from them which is thin, pelucid, and volatile, but in such small quantity that even from two bags of these leaves scarcely three drachms of the oil are obtained. The odour of the oil is like that of the strongest cardamoms. Two drops of it in ale or wine excite violent perspiration; in fact, India does not possess a more powerful sudorific.

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The above may be accepted as the substance of what Rumphius actually wrote. One author has given one sentence, another a second, and it has thus transpired that his meaning has been somewhat distorted. The passage regarding distillation is as nearly as possible a literal translation from the original, and it will be seen that it is left doubtful whether the natives distilled the oil or only the Dutch did so, during Rumphius' time. Flückiger & Hanbury suggest the latter, and in this view they may be correct, since the information regarding the distillation forms a separate paragraph after the undoubtedly native uses have been detailed. The learned authors of the Pharmacographia then give the history of the introduction of Cajuput into Europe. It appears, they say, "to have been first noticed by J. M. Lochner, of Nürnberg, a physician to the German Emperor. About the same time (1717), a ship's surgeon, returning from the East, sold a provision of the oil to the distinguished apothecary Johann Heinrich Link, at Leipzig, who published a notice of it and sold the supply. It began then to be quoted in the tariffs of other German apothecaries, although it was still reputed a very rare article in 1726." "In France and England, it was, however, scarcely known till the commencement of the present century, though it had a place in the Edinburgh Pharmacopœia of 1788. In the

London Price Current, we do not find it quoted earlier than 1813, when the price given is 3*s.* to 3*s.* 6*d.* per ounce, with a duty of 2*s.* 4½*d.* per ounce."

TRADE. 344 Manufacture and Trade.—Early mention (1792) is made of its preparation in the Island of Bouro, and Bickmore, an American traveller who spent three months in that island in 1865, states that Bouro then produced 8,000 bottles annually. Flückiger & Hanbury, in continuing the account of the preparation, add: "The Trade Returns of the Straits Settlements published at Singapore show that the largest quantity is shipped from Celebes, the great island lying west of Bouro." "The oil is imported from Singapore and Batavia, packed in glass beer or wine bottles. From official statements it appears that the imports into Singapore during 1871 were as under:—

From Java	445	gallons.
,, Manilla	200	,,
,, Celebes	3,895	,,
,, other places	350	,,
TOTAL	4,890	

Of this large quantity, the greater portion was re-shipped to Bombay, Calcutta, and Cochin-China."

MEDICINE. OIL 345 Medicinal Properties.—"Cajuput OIL is very fluid, transparent, of a fine green colour, has a lively and penetrating odour analogous to that of camphor and cardamom and a warm pungent taste. It is very volatile and inflammable, burning without any residue. The sp. gr. varies from 0·914 to 0·9274. Its composition, according to Blanchet & Sell, is $C_{10}H_{16}H_2O$, and by repeated distillation over phosphoric oxide the hydrocarbon $C_{10}H_{16}$ called *Cajuputene*, can be obtained. The oil is, therefore, said to contain *Cajuputene hydrate* or *Cajuputol*. It boils at 175°C (347° Fh.)" "The green colour has been ascribed to a salt of copper, derived from the vessels in which the distillation is performed; and Guibourt obtained two grains and a half of oxide of copper from a pound of the commercial oil. But neither Brande nor Gœrtner could detect copper in specimens examined by them; and M. Lesson, who witnessed the process for preparing the oil, at Bouro, attributes its colour to chlorophyll, or some analogous principle, and states that it is rendered colourless by rectification. Guibourt cultivated over obtained a green oil by dist[illation] in Paris. A fair inference is that the oil of Cajuput is naturally green, but that, as found in commerce, it sometimes contains copper, either accidentally present, or added with a view of imitating or maintaining the fine colour of the oil (*U. S. Dispensatory*)." The copper may be removed by distillation with water or agitation with a solution of ferrocyanide of potassium. The colour is thus destroyed, but it may be restored by exposure to copper filings (*Mr. Edward Hirted, Pharm. Jour. & Trans.* (3), *II.*, *804*). The high price of Cajuput oil has led to its adulteration, oil of rosemary, or that of turpentine, impregnated with camphor and coloured with the resin of millfoil is said to be the most common adulterant. The quantity of copper in Cajuput is, however, too small to render the oil unfit for medicinal use (*Watts' Dict. Chem.*).

The oil is highly stimulant, producing a sense of heat with increased fulness and frequency of the pulse, exciting in some instances profuse perspiration. Ainslie says, "Kijaputi oil is hitherto but little known to the native practitioners of India; it is in use, however, amongst the European medical men of that country, who recommend it, when mixed with an equal quantity of some mild oil, as an excellent external application in chronic rheumatism. The Malays are in the habit of prescribing it internally, and I understand with great success, in what they call *pitam kédi* and *bérpi* (epi-

lepsy and palsy). It is, no doubt, a highly diffusible stimulant, antispasmodic, and diaphoretic, and may be efficaciously given in dropsy, chronic rheumatism, palsy, hysteria, and flatulent colic; the dose from two to six or even seven drops, on a lump of sugar." Ainslie adds that it dissolves caoutchouc or India rubber, by which means a good varnish may be made. It is officinal in the Indian and British Pharmacopœias: in the former it is said to be used with advantage in depression of the vital powers. "In cholera it has been lauded but on insufficient grounds. It proves useful also in flatulent colic, painful spasmodic affections of the stomach, hysteria, &c. Externally it forms a valuable embrocation in rheumatic, neuralgic and other painful affections, in paralysis, &c." MEDICINE.

CHEMISRTY.—The chemical nature of this substance has already been dealt with, but the account given in the Pharmacographia (reproduced in *Dymock's Mat. Med., W. India*) may be consulted. In the volumes of *Watts' Dictionary of Chemistry* (*l.c.*), the substance is dealt with in detail and the properties of its compounds with chlorine, bromine, and iodine investigated. The oil is then stated (but apparently incorrectly) to be "prepared in India," the green colour being accounted for as due to "a resinous colouring matter dissolved in it in very small quantity." "The colour of the crude oil is also partly due to copper, the presence of which may be accounted for, either by the use of a copper head in the distilling apparatus of the Hindus, or by intentional adulteration, resorted to for preserving the green colour of the oil." Chemistry. 346

SPECIAL OPINIONS.—§ "Very useful application in chronic rheumatism' (*Surgeon-Major and Civil Surgeon G. Y. Hunter, Karáchi*). "Stimulant, carminative, useful in flatulence and colic; rubefacient externally; applied to cold extremities in collapse of cholera and fever" (*Assistant Surgeon S. C Bhattacharji, Chánda, Central Provinces*). "Have used it as a stimulant and rubefacient for local application only in chronic rheumatism" (*Assistant Surgeon Nehal Sing, Saháranpur.*) "Cajuput oil is a powerful restorative in cholera" (*Civil Surgeon G. C. Ross, Delhi, Panjáb*).

Structure of the Wood.—Reddish-brown, hard (*Gamble*). TIMBER. 347

(*J. Murray.*)

MELANOCENCHRIS, *Nees; Gen. Pl., III., 1169.*

Melanocenchris Royleana, *Nees; Duthie, Fodder Grasses of N. India, 54;* GRAMINEÆ. See "Food and Fodder for Cattle," (Vol. III., 424). 348

Melanogaster durissimus, *Cooke;* FUNGI; see Vol. III., 455; also Truffle, Vol. VI., Pt. II.

MELANORRHŒA, *Wall.; Gen. Pl., I., 421.* 349

A genus of trees, the juice of which forms a varnish, and which comprises four species, all natives of India or the Malay Archipelago.

Melanorrhœa glabra, *Wall.; Fl. Br. Ind., II., 25;* ANACARDIACEÆ. 350

Vern.—*Thit-sae-yaing, thitsi, thitse,* BURM.

References.—*Kurz, For. Fl. Burm., I., 317; Mason, Burma and Its People, 514, 774; Liotard, Dyes, App. IX.*

Habitat.—Found in the forests of Tenasserim and Mergui.

Resin.—This tree yields a similar exudation to that of the next mentioned species, but there is no record of its having been applied to any use in the arts. RESIN. 351

MELANORRHŒA usitata. — The Black Varnish Tree.

352 **Melanorrhœa usitata**, *Wall.; Fl. Br. Ind., II., 25.*

THE BLACK VARNISH TREE OF BURMA.

Vern.—*Khen*, MANIPUR; *Thitsi* or *thit-tse*, *thitsibin*, BURM.; *Sâthan* TALEING; *Kinhong*, KAREN.

References.—*Kurz, For. Fl. Burm., I., 318; Gamble, Man. Timb., 110; Mason, Burma and Its People, 514, 774; Pharm. Ind., 69; Gums and Resinous Prod. (P. W. Dept. Rep.), 32, 38, 62; Liotard, Dyes, App. IX.; Cooke, Gums and Resins, 120; Alpin. Report Shan States, 1887-88; Gazetteer:—Burma, I., 126, 134; Agri.-Hort. Soc.:—Ind. (Trans.), VI., 177, (Pro.) 95; VII., (Pro.) 23-24, 25, 41; Journals (old series), IV., 215; VII., 73; IX., Sel., 45; XI., 446; Indian Forester, I., 362; II., 172, 181; VIII., 409, 412, 419; XIV., 394; Spons' Encycl., 1692; Balfour, Cyclop. Ind., II., 920; Smith. Dict., 426.*

Habitat.—A large deciduous tree, frequent in the open forests (especially the *In* and hill *In* forest—see Dipterocarpus, Vol. III., 100-171), rare in the dry forests, from Prome, Pegu, and Martaban down to Tenasserim; also found in Ava and Manipur. It ascends to an altitude of 3,000 feet.

OLEO-RESIN. 353 Oleo-resin.—Every part of the tree abounds in a thick, viscid, greyish, terebinthinate fluid, which soon assumes a black colour on exposure to the air. This is the famous black varnish or *thitsi* of the Burmese, by whom it is very extensively employed not only in the arts but in medicine.

The tree was first reported on by Dr. Wallich, who gave a description of its habitat, method of growth, and of the oleo-resin which it yields, in his *Plantæ Asiaticæ Rariores*. He writes: "In the neighbourhood of Prome, a considerable quantity of VARNISH is extracted from the tree, but very little is obtained at Martaban, owing, as I was told, to the poverty of the soil, and partly also to the circumstance of there being none of the people in that part whose business it is to perform the process. This latter is very simple:—Short points of a thin sort of bamboo sharpened at one end like a writing pen, and shut up at the other, are inserted in a slanting direction into wounds made through the bark of the trunks and principal boughs, and left there for twenty-four to forty-eight hours, after which they are removed, and their contents, which rarely exceed a quarter of an ounce, emptied into a basket made of bamboo or rattan previously varnished over. As many as a hundred bamboos are sometimes seen sticking into a single trunk during the collecting season, which lasts as long as the tree is destitute of leaves, namely, from January until April; and they are renewed as long as the juice will flow. A good tree is reckoned to produce from 1½ to 2, 3, and even 4 viss annually, a viss being equal to about 3⅓ lb avoirdupois. In its pure state it is sold at Prome at the rate of one tical, or 2*s.* 6*d.*, per viss. At Martaban, where everything was dear when I was there, the drug was retailed at 2 Madras rupees per viss; it was of inferior quality and mixed with sesamum oil, an adulteration which is often practised.

Varnish. 354 "The extensive use to which this varnish is applied indicates that it must be very cheap. Almost every article of household furniture destined to contain either solid or liquid food is lacquered by means of it. At a village close to Pagam on the Irrawaddy, called Gnauné, where this manufacture is carried on very extensively, I endeavoured to obtain some information relating to the precise mode of lacquering; but I could learn nothing further regarding this than that the article to be varnished must first be prepared with a coating of pounded calcined bones; after which the varnish is laid on thinly, either in its pure state, or variously coloured by means of red or other pigments. I was told that the most essential, as well as difficult, part of the operation consists in the process of drying, which must be effected in a very slow and gradual manner, for which purpose the articles are placed in damp and cool subterraneous vaults, where

The Black Varnish Tree. (*J. Murray*) MELANORRHŒA usitata.

OLEO-RESIN.

they are kept for several months, until the varnish has become perfectly dry.

"Another object for which the drug is extensively employed is as a size or glue in the process of gilding; nothing more being required than to besmear the surface thinly with the varnish, and then immediately to apply the gold leaf. If it is considered how very extensively the art is practised by the Burma nation, it being among their most frequent acts of devotion and piety to contribute to the gilding of their numerous religious edifices and idols, it will be evident that a great quantity of the drug must be consumed for this purpose alone. Finally the beautiful *Páli* writing of the religious order of the Burmans on ivory, palm-leaves, or metal is entirely done with this varnish in its native and pure state." Little can be added to the above exhaustive account, but it may be noted that according to Mason quoting Major Berdmore, the varnish mixed with bone-ashes is also used as a paste for sticking glass on boxes and images.

The following more detailed account by Sir D. Brandis of the method of collection is also of interest:—

"The trees which have been tapped are at once known by triangular scars about 9 inches long and 5 inches broad, the apex pointing downwards.

"On some trees we counted 40—50 of these scars, and some of them at a height of 30 feet. To work the higher scars the Shans use a most ingenious ladder which is permanently attached to the trees. It consists of a long upright bamboo with holes cut through at intervals of 2—3 feet. Through each hole are passed two flat bamboo sticks driven with their pointed ends into the bark. These form the spokes of the ladder and are about 12 inches long. The scars or notches to extract the varnish are made with a peculiarly shaped chisel about 15 inches long, the handle is of iron, of one piece with the chisel and about 9 inches long, the lower end thicker, hollow, and closed with a bamboo plug The chisel is wedge-shaped, about 6 inches long (the edge half an inch broad), and forms an obtuse angle with the handle.

"With this instrument two slanting slits meeting at an acute angle, are made upwards through the bark, and the triangular piece of bark between the two slits is thus slightly lifted up, but not removed. A short bamboo tube about 6 inches long, with a slanting mouth and a sharpened edge, is then horizontally driven into the bark below the point where the two slits meet, and the black varnish which exudes from the inner bark near its contact with the wood runs down into the bamboo tube, which is emptied at the end of ten days, when it ceases to flow. A second cut is then made so as to shorten the triangular piece of bark which had been separated from the wood when the first cut was made. A shorter triangular piece of bark remains, ending in an angle less acute than before.

"The bamboo tube is then moved a little higher, and the edges of the original cut are cut afresh. The varnish then runs out for another ten days, after which the scar is abandoned. The trees vary in yield exceedingly; a crooked tree with scanty foliage which we examined was said to yield a good outturn, while some of the largest trees were said to yield very little. We saw trees tapped which had a diameter of only 9 inches. Moungmyat informed us that one man could make and look after 1,200 scars; that he could do 200 in a day, so that the whole number occupied six days, which left four days for rest. They only work in those parts of the forest where the tree is abundant and trees fit to tap stand close together. The tree yields nothing while it is leafless in the hot season, and the best season for working is from July to October. One man collects 40—50 viss (146 to 182lb) in one season: at Tyemyouk the viss sells for 12 annas and at Rangoon for one rupee."

MELASTOMA malabathricum. The "Indian Rhododendron."

OLEO-RESIN.

In Manipur the tree attains very large dimensions and forms extensive forests from the top of the Kabo Valley for many miles in a northerly and north-easterly direction towards the Chinese frontier. The natural varnish is used, as in Burma, for many purposes, among which may be mentioned that of painting river-crafts, vessels destined to contain liquids, and scabbards. It is said to be conveyed to Sylhet for sale by the merchants who come down annually with horses.

Physical Characters. 355

PHYSICAL CHARACTERS.—The varnish is thick at ordinary temperatures, and of a dull leaden grey colour, but wherever it comes in contact with the air it assumes, in a very short time, a shining black surface. Alcohol, spirits of turpentine and benzole, combine with and dissolve it, rendering it more fluid. It may also be diluted with gold size, which tends to improve its drying properties, and intensify its colour, whilst the solvents above enumerated have a tendency to turn it brown. The varnish is very commonly adulterated with gingelly oil. It has peculiarly acrid properties, and hence has to be handled, when in the fresh state, with great care, for it frequently produces violent erysipelatous swelling, accompanied by pain and fever. These effects are said to be more marked in Europeans than in Natives accustomed to collecting the substance.

Trade 356

TRADE.—The varnish is little known or appreciated outside the area of its production. Attempts have been made to introduce it into European commerce, but since it has no special application and is so long in drying, it is stated to have no value in the European market.

MEDICINE Oleo-resin. 357

Medicine.—Black varnish is extensively employed by the Burmans as an anthelmintic in cases of Ascaris lumbricoides (round worm), as a remedy for which it is said to possess considerable power. It is administered as an electuary, prepared with an equal proportion of honey, the mixture having been subjected for some hours to the action of heat. The dose is one, two, or three table-spoonfuls of the electuary, according to the age of the patient, and is followed in a few hours by a dose of castor-oil, which causes the expulsion of the worms in a lifeless state, thus shewing that the remedy exercises a specific effect on the entozoa. The extremely nauseous taste of the drug and the largeness of the dose required, are great objections to its employment. It appears probable, however, that its activity resides in a volatile oil, which, if procurable in a pure state, would be well worthy of an extended trial.

Those pustulous swellings caused by the fresh juice, in certain constitutions, are said to be effectually removed by the local application of an infusion of teak-wood—**Tectona grandis**, *Linn.* (*Pharm. Ind.*).

TIMBER. 358

Structure of the Wood.—Dark red with yellowish streaks, turning very dark after long exposure, very hard, close and fine grained, weight from 54 to 62lb per cubic foot. When green it sinks, but when dry it floats in water. It is employed for making tool handles, and anchor stocks, and is said in the *Gazetteer of Burma* to be preferred by charcoal burners to the wood of any other tree. It has lately been recommended for buildings, railway sleepers, gun-stocks, sheaves, block-pulleys, and other purposes for which a strong but not very heavy wood is required. Mason states that in some Christian villages in Burma the posts of the chapels are made exclusively of this wood. The utilization of the timber in Manipur is said to be to some extent interfered with by the dread which the natives possess of the irritant effects of the oleo-resin.

359 **MELASTOMA**, *Linn.*; *Gen. Pl.*, I., 746.

Melastoma malabathricum, *Linn.*; *Fl. Br. Ind.*, II., 523; *Wight, Ill.*, I. 95; MELASTOMACEÆ.

THE 'INDIAN RHODODENDRON.'

Syn.—M. ORGYGIUM, *Jack*; TIBOUCHINA PRINCEPS, *Griff.*

The Neem Tree. (*J. Murray.*) MELIA Azadirachta.

Var.—adpressum, *Wall.*; M. ANOPLANTHUM, *Naud.*

Vern.—*Choulisi*, NEPAL; *Tungbram*, LEPCHA; *Shapti, tunka*, MICHI; *Myetpyai, myetpyé*, BURM.; *Katakalúwa, mahabowittya, bowitteya*, SING.

References.—*Roxb., Fl. Ind., Ed. C.B.C., 372; Kurz, For. Fl. Burm., I., 503; Gamble, Man. Timb., 199; Thwaites, En. Ceylon Pl., 106; Dalz. & Gibs., Bomb. Fl., 92; Mason, Burma and Its People, 428, 744; Lisboa, U. Pl. Bomb., 156, 245; Gazetteer, Bombay, XV., 72; Ind. Forester, IV., 241.*

Habitat.—A spreading shrub, found growing very abundantly throughout India, from the sea level up to an altitude of 6,000 feet, except towards the Indian Desert. It is not found out of India, *i.e.*, the authors of the *Flora of British India* have narrowed the description of the species to the Indian typical plant which is not found in Malaya, &c. The variety adpressum occurs from Mergui to Singapore and in Penang.

Dye.—The FRUIT yields a purple dye used for cotton-cloths (*Lisboa*). DYE. Fruit. 360

Food.—The ovoid, truncate FRUIT has an edible pulp, which is said to strongly resemble the blackberry of temperate regions in taste and flavour. FOOD. Fruit. 361

Domestic, &c.—Gamble states that "this is probably the *lutki* bush on which the silkworm Attacus atlas is often found, and fed on which it gives a very fine silk." DOMESTIC. Leaves. 362 363

MELIA, *Linn.; Gen. Pl., I., 332.*

A genus of trees which belongs to the Natural Order MELIACEÆ, and comprises five species; natives of India and the Malay Archipelago.

Melia Azadirachta, *Linn.; Fl. Br. Ind., I., 544; Wight, Ic., t. 17;*

THE NEEM, OR MARGOSA TREE. [MELIACEÆ

Syn.—M. PARVIFLORA, *Moon.*; M. INDICA, *Brandis*; AZADIRACHTA INDICA, *Adr.*

Vern.—*Nim, bál-nimb, nimb, nimb*, HIND.; *Nim, nimgachh*, BENG.; *Nim*, KOL.; *Nim*, SANTAL; *Agas*, PALAMOW; *Betain*, KUMAON; *Nim, mahánim, bukhain, drekh, bakam*, fruit=*darkonah*, PB.; *Nimuri*, SIND.; *Limbo*, C. P.; *Nim, bál-nimb, baká-yan*, BOMB.; *Limba, kadu khajur, nimbay, limbácha-jháda*, MAR.; *Limba, libado, limbado, limb, dánujhada, kohumba*, GUZ.; *Nim*, DEC.; *Vémbu, véppam, véppa-maram*, TAM.; *Vépa, yapa, yeppa, taruka, nim-bamu*, TEL.; *Bévina-marakadbevina-mara, heb-bavu*, KAN.; *Véppa, ariya-véppa*, MALAY.; *Thin, bawtamaka, tamá-bin, thamáká, kamáká*, BURM.; *Kohumba, nimbunimba-gahá*, SING.; *Nimba, arishta, nimba-vrikshaha*, SAN. dist. *Nib, ázád-darakhte-hindí* PERS.

References.—*Roxb., Fl., Ind., Ed., C. B. C., Brandis, For. Fl., 67; Kurz, For. Fl. Burm., I., 212; Beddome, Fl. Sylv., t. 13 (14 by mistake); Gamble, Man. Timb., 69; Dalz. & Gibs., Bomb. Fl., 36; Stewart, Pb. Pl., 32; Burmann, Fl. Ind., 1; Pharm. Ind., 53; Flück. & Hanb., Pharmacog., 154; Fleming, Med. Pl. & Drugs (Asiatic Reser. XI.), 171; Ainslie, Mat. Ind., I., 453; O'Shaughnessy, Beng. Dispens., 244; Irvine, Mat. Med. Patna, 77; Honigberger, Thirty-five years in the East, II., 307; Moodeen Sheriff, upp. Pharm. Ind., 63; Mat. Med. S. Ind. (in mss.), 98; U. C. Dutt, Mat. Med. Hindus, 136; Murray, Pl. & Drugs, Sind., 84; Bent. & Trim. Med. Pl., 62; Dymock, Mat. Med. W. Ind., 2nd Ed., 168; Dymock, Warden and Hooper, Pharmacog. Ind., I., 322; Year-Book Pharm., 1873, 41; 1878, 290; Birdwood, Bomb. Prod., 15, 260, 279; Baden-Powell, Pb. Pr., 335, 557; Drury, U. Pl. Ind., 59; Atkinson, Him. Dist. 741; Useful Pl. Bomb. (Vol. XXV., Bomb. Gaz.), 40, 196, 215, 241, 257, 258, 279, 285, 399; Econ. Prod. N.-W. Prov., Pt. I. (Gums and Resins), 11; Stocks, Report on Sind; Gums and Resinou Prod. (P. W. Dept. Rept.), 1, 21, 42, 44, 49, 50; Cooke, Oils and Oilseeds, 57; Gums and Resins, 9; Indian Fibres and Fibrous Substances, Cross Bevan, King, & Watt, 55; Buchanan, Journey through Mysore and Canara, &c., Vol. I., 9, 250; Statistics Dinajpur, 154; Moore, Man., Trichinopoly, 76; Settlement Reports:—Central Provinces, Chindwára,*

110; Nirsir, 305; Belásporc, 77; Gazetteers:—Bombay, IV., 23; V., 23; VI., 13; VII., 39, 42, 41; XIII., 26; XV., 72; Panjáb, Rohtak, 14; Sialkot, 11; Karnál, 16; N.-W. P., III., 33; Mysore and Coorg, I., 82, 58; II., 7; Oudh, III., 71; Agri.-Horti. Soc., Ind.:—Transactions, VI., 241, VIII., 22; Journals (Old Series), IV., 208; VIII. (Sel.), 156, 178; NIX., Sel., 295, 410, Sel., 47; XI. (Pro.), 24; XII., 328; XIII., 309, 350; (New Series) II., 234; VII., 146, 147; Agri.-Hort. Soc., Panjáb, Proc., 1857; Indian Forester, II., 173; III., 201; V., 497; VI., 125; VII., 264; VIII., 493; IX., 357; XII., 188, App., 1, 27; XIII., 69, 129, 339; XIV., 391.

Habitat.—A large tree of 40 to 50 feet in height, common, wild or more often cultivated, throughout the greater part of India and Burma.

GUM. 364 Bark. 365

Gum.—The BARK exudes a clean, bright amber-coloured gum, which is collected in small tears and fragments. It is said to form a portion of the commercial gum gattie and of East India gum. It is considerably esteemed medicinally as a stimulant. In the *Pharmacographia Indica* it is described as not bitter, fully soluble in cold water, and unaffected by neutral acetate of lead. "It gives a curdy white precipitate with basic acetate, a reddish gelatinous precipitate with ferric chloride, is unaffected by borax, is slightly reduced by boiling with Fehling's solution which it turns a dull red colour. Iodine does not affect it, but it precipitates with oxalate of ammonia. It makes a weak mucilage, and is of little value."

DYE. Gum. 366 OIL. 367 Bark 368

Dye.—Hove in the account of his Tour in Bombay (1787) mentions the *nim*, and states that the tree yields a bitterish GUM in great abundance, "which I understand the silk-dyers use in every preparation of their colours." In the *Gazetteer of Mysore and Coorg* it is stated that the OIL is employed in dyeing cotton cloths; a statement repeated by Lisboa, who adds that it imparts a deep yellow colour to the fabric. The writer can find no other mention of the dye properties of either gum or oil. Stocks states (*Report on Sind*) that the BARK is used to dye red.

FIBRE. Bark. 369

Fibre.—The BARK yields a fibre which is of little economic value, but is commonly employed in the local manufacture of rope. Dr. Watt, in the Report on Indian Fibres exhibited at the Colonial and Indian Exhibition, writes: "It would never pay, however, to extract this fibre for commercial purposes, since the trees take years to grow, and would be killed by a wholesale process of decortication."

OIL. 370 Seed. 371

Oil.—A fixed, acrid, bitter oil, deep yellow, and of a strong disagreeable flavour, is extracted from the SEED by boiling or pressure. It is already manufactured to a considerable extent and forms an article of export from Ma[illegible] chiefly to Ceylon. [illegible]derably used by the poorer classes [illegible]mistic and antiseptic, [illegible] in lamps, but is said to smoke offensively.

Chemical Composition. 372

CHEMISTRY OF THE OIL.—The oil and other products of the *nim* have recently been very carefully analysed by Surgeon-Major Warden, who published his results originally in the *Pharmaceutical Journal*, and has reproduced them in the *Pharmacographia Indica*. As these are of great interest and may serve to decide the commercial utility of this cheaply prepared and abundant oil, they may be here quoted in entirety:—

"Margosa or Nim oil extracted from the seeds had a specific gravity of 0·935 at 15·5 C.; at about 10°—7° C. it congealed without losing its transparency. After standing for about 30 hours the recently expressed oil deposited a white sediment, which, examined microscopically, was found to be amorphous. The colour reactions of margosa oil were not characteristic. With concentrated sulphuric acid a rich brown colour was yielded, and a strong garlic odour evolved. By Massie's test with nitric acid the oil became almost immediately of a reddish colour; after standing for one hour and thirty minutes the colour was pale yellow. The elaidin

OIL. Chemical Composition.

reaction conducted according to Poutet's directions yielded a solid firm yellowish product after eighteen hours, the temperature in the laboratory varying between 89° and 93° F. Exposed in a thin layer on a glass plate to a temperature of 100°C. for some days the oil did not dry or become tacky. The oil was easily soluble in ether, chloroform, carbon bisulphide, benzole, &c. Absolute alcohol, agitated with it was coloured greenish; on separating the alcohol, and evaporating off the spirit, an extract was obtained which consisted of oil, from which a small residue, whitish in colour, separated on standing. The alcoholic extract was very bitter, and possessed in a marked degree the peculiar odour of the oil The whitish residue deposited from the oil separated by alcohol, and examined microscopically, did not appear crystalline. Margosa oil after repeated agitation with alcohol was found to have lost its bitterness and almost wholly its alliaceous odour.

"A known weight of the oil was saponified with alcoholic potash, the alcohol completely evaporated off, and the soap dissolved in water. On agitating the aqueous solution of the soap with ether, 1·60 per cent. of ether extract was obtained of an orange-yellow colour and bitter. This extract, treated with 60 per cent. alcohol, left a small amount of white residue, which had the character of a wax. The aqueous solution of the soap, after separation of the ether, was heated for some time to remove dissolved ether, the solution was then mixed with dilute sulphuric acid in excess, and the insoluble separated from the soluble fat acids in the manner recommended by Allen. The soluble fatty acids amounted to 3·519 per cent., the insoluble to 89·128 per cent. The volatile acids consisted of butyric and a trace of valeric acid. During the distillation to separate the fluid from the volatile fatty acids, a small amount of a snow—white fatty acid passed over; this acid had a melting point of 43·6° C., which corresponds with the fusing point of lauric acid. A weighed portion of the insoluble fatty acids, from which the lauric acid had not been separated, was dissolved in alcohol, and titrated with normal standard soda, using phenolphthalein as an indicator, ·288 gram of the acids required 1 c.c. of caustic soda for neutralization. No attempt at separating the fixed fatty acids was made; they probably consisted of a mixture of stearic and oleic acids, with a small amount of lauric acid.

"Examined by Reichert's distillation process, 2·5 grams of the oil gave a distillate which after separation of the lauric acid, which had distilled, required 4·6 c.c. of decinormal soda for neutralization, phenolphthalein being used as an indicator.

"The saponification equivalent of the oil was determined by Koettstorfer's method, and was equal to 284, the percentage of caustic potash required to saponify the oil being 10·72.

"A preliminary examination of the oil having indicated the presence of sulphur, a quantitative estimation of the amount present was made and found equal to ·427 per cent. The oil after repeated agitation with alcohol was found to contain only ·109 per cent. of sulphur.

"The extract obtained by agitating the oil with absolute alcohol has already been referred to; it was examined in the following manner:—The oily extract was treated with 60 per cent spirit, allowed to stand, and the clear yellow alcoholic solution decanted from the insoluble oil; the alcoholic solution thus obtained was evaporated to dryness, mixed with ammonia, and agitated with ether. The ether solution was marked *A*. The aqueous solution, after separation of the ether, was mixed with dilute hydrochloric acid, and again agitated with ether. The ether separated of a yellow colour, and below it some flocks of a dirty yellow hue, which refused to dissolve after prolonged agitation. The ether solution was marked *B*.

OIL. Chemical Composition.

From the aqueous solution the insoluble flocks were separated by filtration and marked *C*. The filtrate was not further examined.

"*Examination of ether solution A.*—The solution was agitated with dilute hydrochloric acid, to remove any principles of an alkaloidal nature. The ether was then separated and evaporated; the resulting extract was pale amber in colour, viscid at first, very bitter, and had a marked odour of the oil. It contained sulphur. It was easily soluble in 90 per cent. alcohol, ether, chloroform, &c., but insoluble in acids, or in caustic alkaline solutions. It had the properties of a neutral resin.

"The hydrochloric acid solution was of a yellow colour; it was mixed with ammonia, which occasioned a white precipitate, and agitated with ether. The etherial solution on evaporation left a yellow residue, not readily soluble in dilute acids. The dilute sulphuric acid solution was bitter, and yielded a precipitate with alkaline carbonates and hydrates, phosphomolybdic, and picric acids, potassio-mercuric iodide, chloride of gold and perchloride of platinum. This principle had therefore the properties of an alkaloid.

"*Ether solution B.*—On evaporating the ether solution *B*, a dark reddish bitter extract was obtained, soluble in alkaline solutions, and re-precipitated in yellowish flocks by dilute acids. It had the properties of an acid resin.

"*Precipitate C.*—The precipitate was well washed, and dissolved in alcohol; on evaporation a brittle darkish residue was obtained, soluble in alkaline solutions, re-precipitated in yellowish flocks by acids, soluble with very great difficulty in ether, easily soluble in chloroform. This principle thus also had the properties of an acid resin.

"In addition to the principles above described as being present in the oil, an examination of the cake left after expression of the oil, indicated the presence of another neutral principle, insoluble in ether or alkaline solutions, but dissolving in chloroform (*Pharm. Journ.*, *1889*).

"According to Branet the seeds contain from 40 to 45 per cent. of oil.

Oil-cake 373

"Margosa cake is used as a manure in planting districts in Southern India. Two samples had the following composition:—

	1	2
Moisture	6·08	9·93
[illegible] matter	[illegible]	[illegible]

MEDICINE.

arishta="relieving sickness," *pichumarda*=leprosy destroying." U. C. Dutt, in his account of the Sanskrit opinions of the plant, writes:—"The bark is regarded as bitter, tonic, astringent, and useful in fever, thirst, nausea, vomiting, and skin diseases. The bitter leaves are used as a pot-herb, being made into soup and curry with other vegetables. The slightly aromatic and bitter taste which they impart to curries thus prepared is much relished by some. The leaves are, moreover, an old and popular remedy for skin diseases. The fruits are described as purgative and emollient, and useful in intestinal worms, urinary diseases, piles, &c. The oil obtained from the seeds is employed in skin diseases and ulcers. The bark is used in fever in combination with other medicines." "The fresh juice of the leaves is given with salt in cases of intestinal worms, and with honey in skin diseases and jaundice. The juice of *nim* leaves and of emblic myrabolans, quarter of a tola each, are recommended to be given with the addition of clarified butter in prurigo, boils, and urticaria.

"As an external application to ulcers and skin diseases *nim* leaves are used in a variety of forms such as poultice, wash, ointment, and liniment. A poultice made of equal parts of *nim* leaves and sesamum seeds is recommended by Chakradatta for unhealthy ulcerations." As is customary in Sanskrit medicine, the *nim*, leaves, bark, &c., are seldom prescribed alone, but enter into the composition of numerous complex preparations,—for an account of which the reader is referred to Dutt's *Materia Medica of the Hindus.*

This useful tree with its multitudinous valuable properties naturally attracted the attention of the Muhammadans on their arrival in India, and was called by them *Azaddaracht-i-hindi* from the resemblance which it bore to their own *Azedarach*, the Persian lilac. Their knowledge of the medicinal properties of the tree having been derived from the Hindus, they naturally use its various products in the same way, and consider them cold and dry.

The above notice of the properties ascribed to the *nim* by ancient Sanskrit writers might almost exactly apply to the virtues which it is supposed to possess at the present day,—virtues many of which have been strongly confirmed by European practitioners and writers. The value of the bark in the treatment of periodic fevers is noticed by Fra Bartholemo, Sonnerat, Garcia de Orta, Christoval Acosta, and other old writers, but it was first prominently brought forward in 1803 by Dr. D. White of Bombay. Later Dr. W. R. Cornish, Dr. Wyndour, and others, carefully examined and experimentally tested it, and the result, as expressed by the former, is to the effect that margosa bark is nearly as effective in the treatment of intermittent fever as cinchona or arsenic. Dr. Forbes (*Madras Med. Reports, 1855*) arrived at a similar conclusion, a conclusion which has generally been corroborated by later investigators.

The following are the virtues ascribed to the various parts of the tree and the diseases for which they have been recommended by modern writers on *Indian Materia Medica* and *Therapeutics;* notably by Moodeen Sheriff in his forthcoming *Materia Medica of Madras.*

The bark, root-bark, and young fruit are useful in slight cases of intermittent fever and general debility. The root-bark is more active and speedy in its action than the bark and young fruit. The oil has proved a useful local stimulating application in some forms of skin disease, ulcers, rheumatism, sprains, &c., and is antiseptic It is also a useful adjunct to *chaulmugra* oil (see Gynocardia odorata) in cases of leprosy. Its antiseptic property might be taken advantage of for the manufacture of a medicated soap, since the oil readily saponifies. This soap might be very serviceable for the purpose of washing sores, &c., and for the general uses to

the Neem Tree. (*J. Murray.*) MELIA Azadirachta.

MEDICINE.

The *ním* tree is generally supposed by its presence to materially improve the health of a neighbourhood. Believed to be a prophyllactic against malarial fever, and even against cholera, it is frequently planted near buildings and villages. Even Europeans believe in this property to some considerable extent, especially in the North-West Provinces and Oudh, and villages surrounded with *ním* trees are frequently cited as proverbially free from fever, when neighbouring villages suffer severely. It is extremely doubtful, however, whether this tree exercises a beneficial effect to a greater extent than any other. A somewhat similar effect is supposed by the natives to be produced on syphilis, the air waved with a *ním* branch being considered a cure for that disease.

A plant with so many reputed properties has naturally been much used by European practitioners in India, and has obtained a place in the *Indian Pharmacopœia.* The officinal preparations are the powdered bark, the fresh leaves, a decoction and tincture of the former, and a poultice of the latter. The bark is said to be astringent, tonic and antiperiodic, the leaves to be a stimulant application to "indolent and ill-conditioned ulcers"

Chemistry. 383

CHEMISTRY OF THE BARK, LEAVES, &C.—The chemistry of the gum and oil has been already discussed. That of the bark and leaves is of particular interest from a medicinal point of view, and is described as follows by Flückiger & Hanbury.

"Margosa bark was chemically examined in India by Cornish (1856), who announced it as a source of a bitter alkaloid to which he gave the name of *margosine*, but which he obtained only in minute quantity as a double salt of margosine and soda, in long white needless. The small sample of bark at our disposal only enables us to add that an infusion produced with perchloride of iron a blackish precipitate and that an infusion is not altered by tannic acid or iodo-hydrargyrate of potassium. If the inner layers of the bark are alone exhausted with water, the liquid affords an abundant precipitate with tannic acid; but if the entire bark is boiled in water, the tannic matter which it contains will form an insoluble compound with the bitter principle, and prevent the latter being dissolved. It is thus evident that to isolate the bitter matter of the bark, it would be advisable to work on the liber or inner layers alone, which might readily be done as they separate easily."

According to the more recent researches of Broughton published in the *Madras Monthly Jour. of Med. Science* and quoted in the *Pharm. Jour., 1873*, and the *Year-Book of Pharmacy. 1873, p. 41*, the bitter principle is due to a resin, which it is very difficult to obtain in a state of purity. Broughton succeeded in obtaining a nitro-compound, which yielded a silver salt, not however crystalline, from which he ascribes to the resin the formula $C_{36}H_{50}O_{11}$, that of the nitro-compound being $C_{36}H_{46}(NO)_4O_{11}$. The resin is not, therefore, an alkaloid, since it contains no nitrogen. If required for medicinal purposes, the most suitable and convenient mode of administration would be an alcoholic solution of the resin.

The leaves also contain a bitter principle, more readily soluble in water than the resin above described, of which it is a hydrate. This substance also occurs in the bark, and closely resembles the resin in properties. The leaves contain no peculiar alkaloid, and the powerful smell of the tree was found not to be due to the presence of a sulphuretted oil as had been surmised.

SPECIAL OPINIONS.—§ "*Ním* oil is a valuable remedy in Veterinary Surgery for foul sores. It is stimulating and healing" (*Surgeon-General W. R. Cornish, F.R.C.S., C.I.E., Madras*). "The leaves made into a pulp may be applied externally over the mammæ as a lactifuge" (*Surgeon W. F.*

MEDICINE

Thomas, 32nd M.N.I., Mangalore). "I have extracted the bitter principles from the bark and have found them a very efficient febrifuge. A strong decoction of the bark used every hour in remittent fever has had the desired effect when other febrifuge remedies had failed. In ulcers and skin diseases a poultice made of the leaves acts, I think, as an antiseptic, not as a topical stimulant" (*Surgeon K. D. Ghose, M.D., M.R.C.S., Khulna*). "I frequently use the infusion of the bark as a tonic and antiperiodic with the best results" (*Honorary Surgeon E. A. Morris, Trankebar*). "Used here as a tonic in convalescence from fevers. For this purpose a very cheap and useful mixture in dispensary practice consists of Quinetum grs. v., Nit. Hyd. dil. m. x., and infusion of Nim bark ʒi three times a day" (*Surgeon-Major L. C. Nanney, Trichinopoly*). "The leaves applied to the breasts arrest the secretion of milk" (*Surgeon-Major F. North, Bangalore*). "*Margosa* bark is used as tonic vermifuge (for Ascaris vermicularis)" (*Surgeon-Major H. D. Cook, Calicut, Malabar*). "The powdered bark is frequently used as an antiperiodic in dispensary practice, but is much inferior to cinchona and its preparations" (*Surgeon G. Price, Shahabad*). "The oil of the seeds is useful for the destruction of lice, and as an application in urticaria and eczema" (*Narain Mister, Kothe Bazar Dispensary, Hoshangabad, Central Provinces*). "The bark in the form of decoction is a fairly efficient antiperiodic in mild agues. The leaves used as a poultice form a very useful application for foul ulcers often exciting a healthy action when other remedies have failed. The seeds are prized by the natives who express an oil from them. The latter is used for lighting purposes, and as an application in skin diseases" (*Surgeon S. H. Browne, M.D., Hoshangabad, Central Provinces*). "As a febrifuge, tonic and alterative, the decoction of the bark is efficacious in fevers. The leaves are applied to ulcers and in a variety of skin diseases. The fresh juice is used as an alterative in leprosy and skin diseases, but I found it of no use in a case of leprosy after a prolonged trial. A popular belief exists that a leper can be cured if he can live exposed under a *nim* tree for 12 years. The slender twigs are largely used as tooth-brushes (*datun*), the continued use of which is said to keep the system free from all complaints and certainly keeps the mouth and breath clean and sweet" (*Assistant Surgeon S. C. Bhuttacharji, Chanda, Central Provinces*). "An ointment made from the leaves fried in *ghi* and subsequently mixed with wax makes a good stimulating application for [illegible] the infusion of the bark is useful as an antiperiodic and

the Neem Tree. (*J. Murray.*) MELIA Azadirachta.

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body; it decidedly promotes recuperative efforts of the skin and thus exerts a favourable influence in the course of this disease. The action is greatly superior to gingelly or cocoanut oil and carbolic acid. It forms a valuable remedy for fleas in dogs and for obstinate mange in the same animals. As an antiseptic stimulant applied to wounds, it deserves investigation" (*Surgeon W. G. King, M.B., Madras*). "A decoction of the leaves is used as a wash for unhealthy ulcers. The green leaves are considered antibilious and are used by the natives as an adjunct to some curries" (*Surgeon A. C. Mukerji, Noakhally*). "The bark is a good substitute for quinine in the chronic stage of fever when the latter drug disagrees with a delicate stomach. The oil is also used for scabies and superficial ulcers" (*Civil Medical Officer W. Forsyth, F.R.C.S., Edin., Dinájpore*). "Decoction of the bark given in cases of chronic fever complicated with diarrhœal Leaves most useful for fomentations and poultices" (*Civil Surgeon S. M. Shircore, Moorshedabad*). "The decoction of the bark is a valuable febrifuge and antiperiodic. The sprouts with black pepper form a good antiperiodic in chronic intermittent fever" (*Assistant Surgeon Nanda Lall Ghose, Bankipore*). "The leaves are used as a bitter tonic, also in the form of paste or poultice as a remedy for unhealthy ulcers and sores, and in the form of decoction as an antiseptic lotion. The bark is a substitute for cinchona bark, and a bitter principle prepared from it is used by native physicians as a substitute for quinine. The oil expressed from the seeds is a good application in old unhealthy sores and in leprosy. The tender leaves taken internally are used as a cure for leprosy" (*Civil Surgeon J. H. Thornton, B.A., M.B., Monghyr*). "I have used the decoction of the bark for its tonic and antiperiodic properties in chronic cases with good results. A decoction of the leaves has been used as a lotion for wounds and ulcers with some success. The young leaves are often used cooked as an article of food and fried with brinjal to which they impart a mild bitter taste. Also made into a curry with other vegetables. They are believed to have alterative properties" (*Civil Surgeon D. Basu, Faridpore, Bengal*). "A decoction of the bark is useful in fever and during convalescence; the leaves in fomentations for sprains and glandular swelling; the oil in rheumatism. All are highly antiseptic" (*Civil Surgeon G. C. Ross, Delhi, Panjáb*). "The leaves—fried, powdered, mixed with ghi, and made into an ointment—form a very efficacious application in sloughing sores and sinuses" (*Assistant Surgeon T. N. Ghose, Meerut*). "A milky fluid which runs from some of the old trees is considered an alterative tonic" (*Civil Surgeon R. Gray, Lahore*). "In 1872 (at Bhuj) I treated a great many cases of ague among sepoys with decoction of *nim* bark: they recovered and returned to duty; but the proportion of readmissions among them was very discouraging" (*Surgeon-Major H. DeTatham, M.D., M.R.C.P., Lond., Ahmednagar*). "The oil of the seeds is a good application in cases of ulcer and excoriation of the scalp—the result of want of cleanliness" (*Civil Surgeon J. Anderson, M.B., Bijnor, N.-W. Provinces*). "Extensively used in the form of poultices to abscesses, carbuncles, and boils. Taken by natives as an anti-scorbutic" (*Civil Surgeon J. McConaghey, M.D., Shajehanpore*). "I have used the bark as an antiperiodic, but not with satisfactory results. Poultices of the leaves seem to suit some indolent ulcers" (*Surgeon G. G. Ward, 5th N. L. I., Mhow*). "Native travellers, whenever possible, sleep under the *nim* at night-time, as the tree is said to ward off fever. The leaf ash mixed with ghi is useful as an external application to psoriasis" (*J. Parker, M.D., Dy. Sanitary Commissioner, Poona*). "(1) Decoction of *Nim* is a valuable tonic and alterative, and is very useful in chronic fevers, during convalescence from febrile complaints, and in cutaneous eruption. (2) As

MELIA Azadirachta. — The Neem Tree.

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a wash for unhealthy sores, it acts as an alterative and antiseptic. (3) A mixture of the bruised leaves with turmeric is rubbed over the body during the desquamative stages of eruptive diseases, such as small-pox. It hastens the separations of the crusts, probably acting as an antiseptic, and promoting the healing of sores. (4) A poultice of the leaves is very useful to hasten suppuration or to disperse inflammation. (5) The leaves are occasionally used with brinjal or other vegetables, and act as an anthelmintic. (6) The expressed oil of the seed I tried in convict lepers for four years in the Bankura Jail. It was used in the form of a bath. In almost all the cases great relief was obtained. The results were as follows:—(*a*) In anæsthetic cases, great improvement followed in sensation and the eruption diminished. In some cases the improvement was so great that they could not be distinguished from healthy men. With hard work or any other debilitating cause, there was, however, a return of the original symptoms. (*b*) In tubercular cases, both thickening and ulceration became less, and in some cases entirely disappeared. (*c*) In the mixed form the effects were no less marked. I tried both this and *Garjan* oil, and I consider *nim* oil the better of the two. The results were noted in my annual medical reports of the Bankura Jail for the years 1879 to 1881" (*Surgeon R. L. Dutt, M.D., Pubna*).

FOOD & FODDER. Leaves. 384 Fruit. 385 Toddy. 386 TIMBER. 387

Food and Fodder.—The LEAVES are cooked with other vegetables in the form of a curry, or are simply parched and eaten. They impart a bitter taste to the food, but this seems to be liked by Natives. They are also used for cattle fodder. Lisboa states that the small sweet pulp of the FRUIT is eaten in the Bombay Presidency, especially in times of scarcity. The TODDY obtained from the tree has already been described.

Structure of the Wood.—Sapwood grey, heart-wood red, very hard, beautifully mottled, weight from 45 to 53lb per cubic foot, transverse strength of bar 2"×1"×1" from 550 to 720lb (*Gamble*). It is strong, clean grained, and resists the attacks of worms. It is much used for the construction of carts, for making agricultural implements, and, in South India, for furniture. Owing to its sanctity and durability, it is largely employed by the Hindus to make idols. A contributor, forwarding specimens to the Agri-Horticultural Society of India in 1861, wrote:—"I can almost confidently state that it resists the action of atmosphere infinitely better than '*teak*' or '*sisú*,' whilst in point of value the *nim* can be procured at one-third less the rate than the latter." He recommended it for carpentry work, and thought it admirably suited for door panels, rails, sash frames, and furniture. It has also been highly recommended for making trunks and chests, which withstand the attacks of white-ants, and are said also to render the contents proof against the ravages of other insects.

DOMESTIC. 388 Twigs 389 Oil 390 Seeds 391 Leaves. 392 Oil-cake 393

Domestic, Sacred, and Agricultural Uses.—As already stated, the TWIGS are largely used as tooth-cleaners, and the OIL is employed for burning. The SEEDS and the oil obtained from them are used as applications to the hair by the women of Sind, both on account of their odour, and also to kill vermin. (*Conf.* with Detergents, Vol. III., 84-92.) The LEAVES are largely used to protect clothes, books, papers, &c., from the ravages of insects, but are inferior to camphor for this purpose, and require to be frequently renewed. The *nim* is extensively planted as an avenue tree for which it is excellently adapted. The leaves and twigs are used for manure, and the OIL-CAKE, as already stated, is considerably employed for the same purpose in the planting districts of Southern India.

The tree is held sacred by the Hindus and takes part in many of their ceremonies. It is believed that when nectar was being taken to heaven from the world below for the use of the gods, a few drops fell on the *nim*. Hence, on New Year's Day of *Shakaliyan shak*, Hindus eat its leaves in

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he hope that they will thereby acquire freedom from disease (*Lisboa*). Buchanan, in his *Journey through Mysore*, relates that, "once in two or three years the Coramás of a village make a collection among themselves, and purchase a brass pot, in which they put five branches of Melia Azadirachta and a cocoanut. This is covered with flowers and sprinkled with sandal-wood water. It is kept in a small temporary shed for three days, during which time the people feast and drink, sacrificing lambs and fowls to Marima, the daughter of Siva; at the end of the three days they throw the pot into the water." In a passage in the *Statistics of Dinajpur*, the same author states that the leaves are much used by holy men to help them to resist the allurements of beauty. The authors of the *Pharmacographia Indica*, commenting on the former passage, write:—"This practice is known in other parts of India as *Ghatásthápan*, and is considered to avert ill-luck and disease." Amongst certain castes the leaves of the *nim* are placed in the mouth as an emblem of grief on returning from funerals. Hove, in his *Tour in Bombay*, writes, "The Gentoors worship this tree, and their barren women invoke and perform the same ceremonies round it every morning as they usually do in the other Pergunnahs about the Ficus religiosa."

Melia Azedarach, *Linn.; Fl. Br. Ind., I., 544; Wight, Ic., t. 160.*

THE PERSIAN LILAC; BEAD TREE.

Syn.—MELIA SEMPERVIRENS, *Sw.*; M. BUKAYUN, *Royle.*

Vern.—*Drek, bakáin, bakáyan, betain, deikna, bakarja, maha-nimb,* HIND.; *Ghoránim, mahá-nim,* BENG.; *Gara nim,* KOL.; *Thamaga,* ASSAM; *Bakainú,* NEPAL; *Bukain,* N.-W. P.; *Chein, kachen, bakáin, dhék, drek, jek,* seed=*habbulbán,* PB.; *Fakyána,* PUSHTU; *Bakayun. drek,* SIND; *Maha limbo, malla nim, muhli,* C. P.; *Gouri-nim, gouli-nim,* DEC.; *Nimb, maha-limbo, drek, bakayan, wilayatí nim,* BOMB.; *Limbara bakána-nimb, wilavati-nimb,* MAR.; *Bakan limbodo,* GUZ.; *Malai, vembu, malai-veppam,* TAM.; *Taraka vépa, makánim, konda-vepa,* TEL.; *Bévu, chik bévu, kadbevina mara, bettada-bevina,* KAN; *Mullay vaempú,* MALAY.; *Ta-ma-ka, ka-ma-ka,* BURM.; *Maha-nimba, lunumidella,* SING.; *Mahánimba, himadruma, parvata-nimba-vrikshaha,* SANS.; *Hab-ul-ban,* ARAB.

References.—*Boiss., Fl. Orient., I., 954; Roxb., Fl. Ind., Ed. C.B.C., 369; Brandis, For. Fl., 68; Kurz, For. Fl. Burm., I., 212; Beddome, Fl. Sylv., t. 14; Gamble, Man. Timb., 70; Dalz. & Gibs., Bomb. Fl., Suppl., 15; Stewart, Pb. Pl., 33; Mason, Burma and Its People, 411,7-8; Sir W. Elliot, Fl. Andh., 184; Pharm. Ind., 55; Ainslie, Mat. Ind., I., 453; O'Shaughnessy, Beng. Dispens., 16; Moodeen Sheriff, Supp. Pharm. Ind., 172; Mat. Med. S. Ind. (in MSS.), 97; U. C. Dutt, Mat. Med. Hindus, 308; Sakharam Arjun, Cat. Bomb. Drugs, 25; Murray, Pl. & Drugs, Sind., 85; Bidie, Cat. Raw Pr., Paris Exh., 108; Dymock, Mat. Med. W. Ind., 2nd Ed., 171; Dymock, Warden and Hooper, Pharmacog. Ind., Vol. I., 330; Year-Book Pharm., 1875, 375; 1880, 204; Birdwood, Bomb. Prod., 279; Baden-Powell, Pb. Pr, 585; Atkinson, Him. Dist. (Vol. X, N.-W. P. Gaz.), 307, 741; Useful Pl. Bomb. (Vol. XXV., Bomb. Gaz.), 41, 286; Gums and Resinus Prod.; P. W. Dept. Rept., 4, 14; Cooke, Oils and Oilseeds, 57; Gums and Resins, 19, 20; Watson, Rept., 4; Settlement Report:—Panjáb, Jhang, 22; Hazára, 10; Pesháwar, 13; Guzrát, 3; Delhi, cciii; N.-W. P., Shahjehánpore, 9; Gazetteers:—Bengal, Orissa, II., 160; Bombay, XIII., 26; XV, 72; XVII, 21; Panjáb, Karnal, 16; Hoshiárpur, 10; Jhang, 17; Amritsar, 4; Sealkot, 11; Rohták, 14; Delhi, 18; Ludhiána, 10; Mysore and Coorg, I., 52, 58; Indian Forester, II., 171, 291, 292,; III., 21, 200; V., 181; VI., 238; VII., 222, 250; VIII., 35; IX., 516; XI., 269, 272, 390; XII., 37, 453, 552, App. 27; XIII., 69, 120; XIV., 391.*

Habitat.—A tree which attains a height of 40 feet, and has a short erect trunk and broad crown; it is commonly cultivated in India, but is wild in the Sub-Himálayan tract at altitudes of from 2,000 to 3,000 feet. It was probably introduced into Southern India by the Muhammadans.

MACROTOMIA, *DC.; Gen. Pl., II., 862.*

32 **Macrotomia Benthami**, *DC.; Fl. Br. Ind., IV., 177;* BORAGINEÆ.

Vern.—It seems probable, as suggested by Stewart, that part of the *Gaozabán* of the bazárs may be this plant. (See Echium, sp., Vol. III., 200.)

Habitat.—Found at 10,000 to 13,000 feet on the Pir Panjál, and on the Western Himálaya frequent, from Kumáon to Kashmír.

MEDICINE. Plant. Medicine.—The PLANT is considered useful in diseases of the tongue and throat (*Stewart*).

33 **M. perennis**, *Boiss.; Fl. Br. Ind., IV., 177.*

34 Habitat.—A herbaceous plant, met with in the Alpine Western Himálaya and Tibet, at altitudes of 10,000 to 14,000 feet; from the Karakoram and Kashmír to Kumáon.

MEDICINE. Root. Medicine.—Stewart, speaking of this plant and of **Onosma echioides**, says: "The bruised ROOT of one or other or both is locally applied to eruptions, and is sent to the plains as the officinal *rattanjot* (see **Potentilla nepalensis**), which is also employed in dyeing wool. Royle assigned *ratanjot* to **Lithuspermum vestitum** (=**Arnebia hispidissima**, *DC.*). In Lahoul, Spiti, and Kanáwar, it is used by the Lamas to stain images, and as a red dye for cloth, being applied with *ghi* or the acid of apricots." Stewart then adds that the leaves of **Onosma** "appear to be most of the officinal *gao-zaban*" (see **Onosma**, Vol. V.). It may be remarked that the habitat of the two plants mentioned above should serve to prevent con-fusion. **Macrotomia perennis** commences at the altitudes at which **Onosma** disappears, as the latter ascends from 5,000 to about 9,000 feet above the sea. **Surgeon-Major J. E. T. Aitchison, C.I E.**, informs the writer that in Afghánistán he found this and the next species used to relieve toothache and earache.

35

36 **M. speciosa**, *Aitch. et Hemsl.; Linn. Soc. Jour., XVIII., 81; XIX., 179.*

Habitat.—Hills above Kaiwás on exposed ridges from 9,000 to 12,000 feet, flowering in July.

MEDICINE. Medicine.—See the remark under **M. perennis**.

37 **Madar**, see **Calotropis gigantea**, *R. Br.;* ASCLEPIADEÆ; Vol. II., 34-49.

Madder, Indian, see **Rubia cordifolia**, *Linn.;* RUBIACEÆ; Vol. VI.

MÆSA, *Forsk.; Gen. Pl., II., 641.*

38 **Mæsa argentea**, *Wall.; Fl. Br. Ind., III., 510;* MYRSINEÆ.

Syn.—BÆOBOTRYS ARGENTEA, *Wall.*

Vern.—*Phusera, gogsa*, HIND.

References.—*Brandis, For. Fl., 283; Gamble, Man. Timb., 238; Atkinson, Econ. Prod., N.-W. P., Pt. V., 77; Himálayan Dist., 313.*

Habitat.—A large shrub of the outer Himálaya, found from Garhwal and Kumáon to East Nepal, at altitudes from 3,000 to 7,000 feet.

FOOD. Fruit. Food.—Produces FRUIT which is larger than those of the other Indian species, and is eaten by the hill tribes.

39

40 **M. indica**, *Wall.; Fl. Br. Ind., III., 509; Wight, Ic., t. 1206.*

Syn.—M. MONTANA, *A. DC.* in part; BÆOBOTRYS INDICA, *Roxb.*; B. NEMORALIS, *Roxb.*

Vern.—*Ramjani*, BENG.; *Tamomban*, MAGH.; *Malmúriya*, SYLHET; *Bilauni*, NEPAL; *Purmo*, LEPCHA; *Phadupjoh*, MICHI; *Kalsís*, KUMAON; *Atki*, BOMB.; *Mata-bimbiya*, SING.

References.—*Roxb., Fl. Ind., Ed. C.B.C., 187, 188; Kurz, For. Fl. Burm., II., 99; Gamble, Man. Timb., 238, 239; Thwaites, En. Ceylon Pl., 172; Trimen, Cat. Ceylon Pl., 50; Atkinson, Him. Dist., 313; Lisboa, U. Pl. Bomb., 272; Bombay Gazetteer (Kánara), XV., Pt. I., 437.*

A Fish-poison. (*G. Watt.*) MAGNOLIA sphenocarpa.

Habitat.—An evergreen, gregarious shrub or small tree, met with throughout India at altitudes up to 6,000 feet; common in the North-East Himálaya, Eastern Bengal, Manipur, Chittagong, and Burma. A specimen of this species has recently been sent to the writer by Mr. A. L. McIntire, of the Forest Department, collected in the Simla District. This is believed to be the most westerly Himálayan habitat hitherto recorded. The form known as Perottetiana, *A. DC.* (now reduced to a variety of M. indica) is found on the Nilghiri hills, and the variety maxima occurs in Assam. Dalzell & Gibson remark that M indica is very common along the Ghâts. Gamble regards this as, next to Artemisia, the commonest woody plant in the Dárjíling district: in some places, especially abandoned cultivation, it forms almost alone a small coppice-like dense forest.

Food.—Brandis says the season of flowering varies from April to October, and that the BERRIES ripen three months later. These are eaten in Nepál. FOOD. Berries. 41

Structure of the Wood.—Growth fast (six rings to the inch); wood soft. Used only for fuel and rough house-posts. TIMBER. 42

Domestic, &c.—According to Brandis the LEAVES are used as a fish poison in Kánara. DOMESTIC. Leaves. 43

Mæsa macrophylla, *Wall.; Fl. Br. Ind., III., 510.* 44

Vern.—*Phusera*, KUMAON; *Bogoti*, NEPAL; *Tugom-kúng*, LEPCHA.

Habitat.—A large shrub or small tree met with in the Eastern Himálaya from Nepál to Bhútan, especially in second-growth forests.

Resin.—A resinous substance exudes on the bark being cut. RESIN. 45

Structure of the Wood.—Light brown, moderately hard; the sapwood resinous. TIMBER. 46

M. rugosa, *Clarke; Fl. Br. Ind., III., 508.* 47

Habitat.—A small tree or stout shrub, with pretty white flowers; found in Sikkim between 5,000 to 7,000 feet, frequent in the upper valleys of the Teesta and Rutong.

Structure of the Wood.—Light brown, soft. The sapwood slightly resinous, annual rings marked by a dark line. TIMBER. 48

MAGNOLIA, *Linn.; Gen. Pl., I., 18.*

[MAGNOLIACEÆ.

Magnolia Campbellii; *H. f. & T.; Fl. Br. Ind, I., 41;* 49

RED MAGNOLIA.

Vern.—*Lal champ*, NEPAL; *Sigumgrip*, LEPCHA; *Pendder, patagari*, BHUTIA.

References.—*Gamble, Man. Timb., 5; List of Darjeeling Plants, 2; Indian Forester :—I., 88, 94, 98; V., 467; VIII., 404; XIII., 52.*

Habitat.—A lofty deciduous tree of Sikkim and Bhútan, from 7,000 to 10,000 feet; common also in Manipur (*Watt*); remarkable for its magnificent large pink or white flowers, which appear in April.

Structure of the Wood.—White, very soft. Weight 25lb per cubic foot. Occasionally used for planking, but now scarce. TIMBER. 50

M. sphenocarpa, *Roxb.; Fl. Br. Ind., I., 41.* 51

Syn.—LIRIODENDRON GRANDIFLORUM, *Roxb.*; MICHELIA MACROPHYLLA, *Don.*

Vern.—*Dúli champa*, BENG. & SYLHET; *Burramtúri*, ASS.

References.—*Roxb., Fl. Ind., Ed. C.B.C., 452; Kurz, For. Fl. Burma, I., 24; Gamble, Man. Timb., 5; Agri.-Hort. Soc. Ind., Trans. V., 119; VII. (1840), 48; Journal, IV., 199; X. (Proc.), 32; (New Series) IV., 96; V., 67 & 68; VI., 35.*